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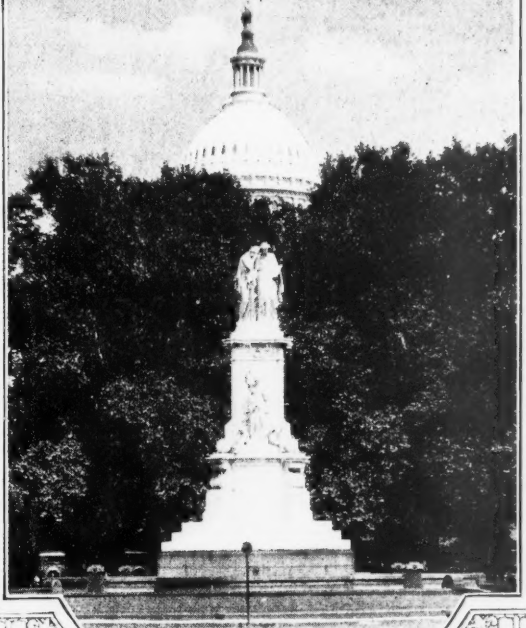
THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION



Washington, D. C.
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Washington, D. C., Oct. 7-11, 1929

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THE JOURNAL
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Original Communications

THE DEVELOPMENT OF THE DENTIN*

By BALINT ORBAN, M.D., Chicago, Ill.

THE subject of the development of the dentin has been somewhat neglected in the past few years. Recent research papers as well as textbooks have expressed such diverging opinions on the steps in this process that it has seemed necessary to conduct further investigations on the subject. New developments in our knowledge of the histology and biology of the connective tissue give promise of aid in elucidating the problem of the development of the dentin.

Waldeyer and J. Tomes believed that the protoplasm of the odontoblasts and their processes, the dentinal fibrils, or Tomes' fibers, becomes directly transformed into the collagenous matrix of the dentin, which later calcifies.

In contrast to this opinion, Koelliker believed that the odontoblasts and probably also some other cells of the pulp secrete the matrix of the dentin and remain intact themselves.

Other investigators have upheld one or the other of these theories.

New light was cast on the question when V. von Ebner found that the matrix of the dentin is not a homogeneous mass, but is fibrous, just like that of bone. Von Ebner describes the fibrils in the dentin as being very fine, and collected into bundles which run at right angles to the surface of the dentinal fibrils. He was of the opinion that the primary builders of dentin were the odontoblasts. These cells elaborate a homogeneous matrix, the "predentin," in which the collagenous fibers later appear.

Mummery, who confirmed von Ebner on the fibrous structure of the dentin, did not clearly express himself with regard to the function of the odontoblasts. He also described some connective tissue fibers as entering the dentin matrix from the pulp, and suggested for them the

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name "odontogenic" fibers. "These fibers," he writes, "are the scaffolding on which the tooth matrix is built up—they are incorporated in the matrix of the dentin by calcification and really form the basis of its substance." Mummery did not express any opinion regarding the origin and nature of the fibers that he saw.

The idea that the odontoblasts function in the production of the dentin was first strongly questioned by K. von Korff. He was the first to study with special histologic technic the fibers of the pulp and the development of the dentin. By using special fixation and staining methods, he was enabled to make the statement that the first matrix of the dentin is not a homogeneous mass as von Ebner stated, but that it is fibrous. In the very beginning of dentin development, there are fibers which run from the pulp to the borderline between the enamel epithelium and the pulp tissue in which no odontoblasts have yet developed. Here, these fibers build a membrane, interweaving with one another, and give rise to the "membrana praeformativa" (Raschkow). This is the first matrix of the dentin and is built by the pulp fibers. Von Korff stated quite clearly that the odontoblasts have nothing to do with the development of the dentin matrix, and that they function only in building those protoplasmic processes (Tomes' fibers) which maintain the circulation in the dentin. Since these investigations, the corkscrew-like fibers which run from the pulp into the dentin matrix are called Korff's fibers.

In Figure 1 is reproduced one of the pictures from von Korff's paper depicting the earliest stages in the development of the dentin of a calf embryo. It was fixed in Flemming's solution, stained with iron-hematoxylin, rubin S and orange G (G. Gruebler, Leipsic). The corkscrew-like fibers are clearly visible between the odontoblasts. The dentin matrix is stained the same color as the fibers and appears to be built up by the spreading out of Korff's fibers. It was by the use of this staining reaction that von Korff concluded that the fibers in the pulp as well as the fibers in the dentin are true connective tissue fibers, i.e., collagenous fibers.

These statements of von Korff have caused heated discussions between some of the most famous histologists, and the matter has not yet been settled. Von Ebner made investigations that did not confirm the statements of von Korff. He found, however, that the fibers indicated by von Korff were present, but he interpreted their appearance and significance differently. Von Korff claimed that the fibers in the pulp which run into the dentin are true collagenous fibers. Von Ebner has definitely shown, especially by the use of polarized light, that there are no collagenous fibers in the embryonic pulp tissue, and that Korff's fibers are not true collagenous fibers, but that the fibers in the dentin are truly collagenous. This statement of von Ebner has been accepted by Studnička, another prominent investigator in this field. Even von Korff himself seems to have accepted this fact. Von Ebner stated that Korff's fibers were similar to collagenous fibers. In the discussion between von Korff, von Ebner, and Studnička, it was decided that Korff's fibers were not collagenous in composition, but of a somewhat similar nature which has been termed "precollagenous." The authors agreed on the nature of the fibers, but differed with regard to their origin. Von Ebner was of the opinion that they were not connective tissue fibers, but fiber-like protoplasmic extensions of the

cells of the pulp, and particularly of the odontoblasts. He claims that the protoplasmic fibers are transformed on the surface of the cells into the collagen-like, homogeneous mass. Consequently, Korff's fibers are not fibers at all, but homogeneous fiber-like structures which are the same as the first-built dentin, i.e., homogeneous predentin. In Figure 2 is reproduced a picture from the work of von Ebner on Korff's fibers. The specimen is of a developing tooth germ of a pig embryo fixed in Flemming's solution and stained with Mallory's stain. Both the fibers and the dentin matrix are stained a homogeneous dark blue. The branching of the fibers at the dentinal side, as shown by von Korff, is not to be seen. Von Ebner believes that the brushlike spreading out of Korff's fibers in the dentin matrix is an artefact, that the first dentin is homogeneous and that Korff's fibers are predentin.

Studnička did not express himself quite clearly on the nature of the fibers. In one of his papers, he calls them "plasmatic fibrils"; in other places, he calls them "precollagen fibers." But he also makes the statement that true collagenous fibers develop from these precollagenous fibers.

Various questions have been brought up in these discussions: 1. Is the first matrix of the dentin homogeneous or fibrous? 2. Is the dentin produced by odontoblasts or by fibers of the pulp? 3. What is the nature of the Korff fibers?

The discussion between von Ebner, Studnička and von Korff resulted in their formulating the following opinions:

Von Ebner: 1. The first matrix of the dentin is homogeneous—"predentin." In this matrix, the true collagenous fibers later develop. (The presence of these fibers in the dentin was shortly confirmed by Mummery. Von Ebner stated that these fibrils run largely at right angles to the dentinal fibrils.) 2. The dentin is built by the odontoblasts or probably in part by the cells of the pulp. 3. Korff's fibers are protoplasmic fibers of the cells, chiefly of the odontoblasts. They are a homogeneous mass, the same as the "predentin."

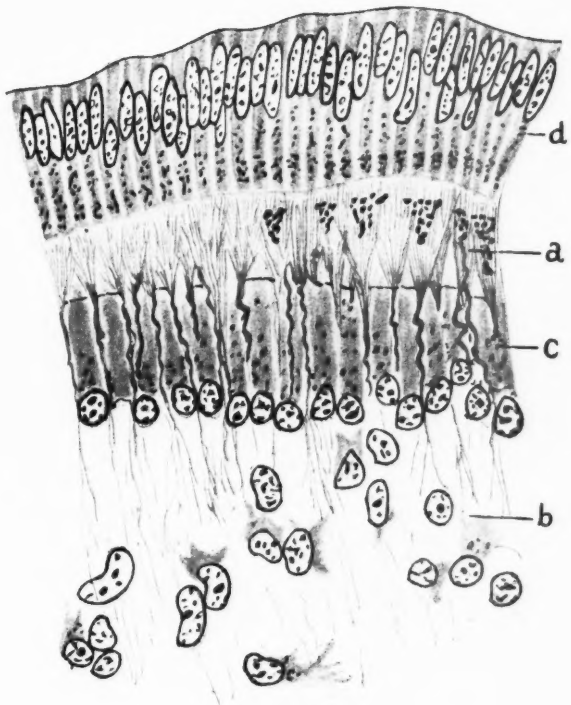
Von Korff: 1. The first matrix of the dentin is fibrous; it is the "membrana praeformativa." 2. The dentin is built by the fibers of the pulp, the odontoblasts having only a secondary function. 3. The fibers are collagenous in nature, or (as he later stated) precollagenous.

Studnička: 1. The first matrix of the dentin is fibrous. The fibers lie in an interfibrillar substance which is present everywhere in the connective tissue. 2. The odontoblasts have a secondary significance and do not build the dentin matrix. 3. The fibers are not homogeneous in nature as von Ebner states, but are truly fibrous, and precollagenous.

Another question arose during this discussion; namely, as to whether the process of development of the dentin is the same from the beginning of its formation to the end, or whether it varies during its progress. Von Korff expressed the belief that dentin development depends entirely on the fibers. Von Ebner has stated that Korff's fibers are present only at the beginning of the development of the dentin, and that when the thickness of the dentin surpasses 80 microns, they disappear, the bulk of the dentin being built only by the odontoblasts, without the production of the fibers. Studnička stated that von Ebner was right concerning the fact that Korff's fibers disappear after a certain time, but he believed that, in the beginning of dentin formation, these fibers were the principal source of the dentin matrix. He also thought that after the dentin had reached

Fig. 1.—Reproduction of a picture from a paper by K. von Korff. Development of the dentin in a tooth of a calf embryo. Corkscrew-like fibers, colored red in this specimen, run from the pulp between the odontoblasts into the dentin matrix, spreading out fanlike. (Stained with iron hematoxylin, rubin S and orange G.) *a*, dentin matrix; *b*, pulp; *c*, odontoblasts, with Korff's fibers between them; *d*, enamel epithelium.

Fig. 2.—Reproduction of a picture from a paper by V. von Ebner. Development of the dentin in a tooth of a pig embryo. (Stained by Mallory's method.) *a*, dentin matrix; *b*, pulp; *c*, odontoblasts, with Korff's fibers between them; *d*, enamel epithelium.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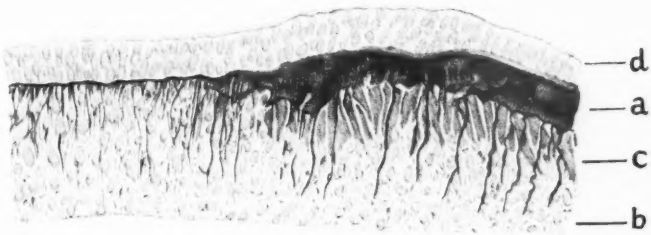
d
a
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a certain width, it grew of itself by growth of its fibrous substance.

One of the arguments of von Ebner against the function of Korff's fibers was that they are at right angles to the surface of the dentin, but that the later collagenous fibers in the dentin run parallel to the surface. Von Ebner could not find the connection between these two fiber systems.

A later investigator, Weidenreich, claimed that the collagenous fibrils in the dentin matrix are not all arranged parallel to the dentin surface, but run at different angles, sometimes in the same direction as Tomes' fibers. He investigated not only mammalian teeth, but also those of the lower species, especially of fish, starting with the pike and the shark. He also investigated the teeth of amphibians and reptiles and thus made a comparative study between them and mammalian teeth. As an outstanding result of these investigations, it was determined that there are two types of dentin. One of these, which Weidenreich calls "cover dentin," covers the outer surface of the dentin and is built by fibers of the pulp in the same way that, according to von Korff, dentin development occurs. The other kind of dentin is "circumpulpar dentin," in Weidenreich's terms. It forms the wider, inner bulk of the dentin and is the product of the odontoblasts of the pulp. He believes that the odontoblasts produce some ferment substance which brings about a precipitation of the matrix.

The three questions formerly answered by von Ebner, von Korff, and Studnička are answered in the paper of Weidenreich as follows: 1. The first matrix of the dentin is fibrous for both the cover and the circumpulpar dentin. (He agrees with von Korff, but differs somewhat from Studnička, who believes that the interfibrillar matrix is present at the same time.) 2. The cover dentin is the product of the fibers of the pulp. The circumpulpar dentin is the secreted product of the cells of the pulp. Weidenreich does not clearly state whether only the odontoblasts or other cells as well are engaged in the production of the matrix. The matrix surrounding the cells seems to have a certain importance. The odontoblasts have their main function in the production of a substance which brings about a precipitation of the fibrous substance in the dentin. 3. The fibers of Korff are true connective tissue, collagenous fibers. This statement places Weidenreich in opposition to von Ebner and Studnička.

Weidenreich further states that the fibers of the cover dentin are rougher than those in the circumpulpar dentin. The fibers in this outer layer run in principally a longitudinal direction; that is, in the direction of the long axis of the tooth. The fibers of the circumpulpar dentin are finer than those of the cover dentin. Von Ebner, who claimed that all fibers in the dentin matrix run parallel to the surface, is opposed by Weidenreich, who shows that they may run in an oblique direction, or around Tomes' fibers. Some may follow the direction of Tomes' fibers.

W. Gebhardt, upon the basis of investigation, came to the conclusion that the arrangement of the collagenous fibers in the dentin depends on the functional influences on the different teeth.

Other investigators have made contentions similar to those already mentioned. Some of them claimed that Korff's fibers are responsible for irregular production of dentin, such as secondary dentin only. Others pay no attention to their presence, and some claim that

Fig. 3.—Reproduction of a drawing made by William Bloom. (Ztschr. f. Mikr. Anat. Forschr., 1929, to be published.) Development of collagenous fibers from argyrophil fibers in a tissue culture.

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they may be found during the entire life of the tooth.

A somewhat different view of the subject has been expressed by G. Jasswoin, who, using different methods, claims that Korff's fibers are processes of special cells lying between and behind the odontoblasts. He calls them "radial" cells. He claims that the radial (Korff's) fibers, as well as the tangential fibers in the dentin (Ebner's), develop as a result of the transformation of the protoplasm (ectoplasm) of the radial cells. The odontoblasts already developed do not produce fibers but may play a rôle in the metabolism of the dentin and probably in its calcification.

A careful review of the literature on the investigations concerning the origin and nature of the connective tissue fibers in general is essential for the proper comprehension of our findings.

One of the outstanding investigators of questions regarding the connective tissue is A. A. Maximow. It was he who, in reviewing the literature on dentin development and discussing the question with me, urged me to investigate this phase of the subject with the use of modern staining methods. Shortly after I had shown him my first specimens and had seen his material on connective tissue fibers, he suddenly passed away. It was he who first observed the development of true connective tissue fibers in tissue cultures. The first fibers that he saw appear were fine fibers near the cells but not inside the protoplasm; they had no connection with the protoplasmic body of the cells. As the tissues in the culture grew older, the fibers became longer and more numerous. They have been called "reticulum fibers" or "precollagen fibers." More recently, the term "argyrophil fibers" has been widely used by German writers, from *argyros,* silver, and *philos,* fond; that is, they have an affinity for silver. They become black on impregnation with silver salts. In further growth of the tissue culture, these fibers become more and more numerous, branching, anastomosing and producing a progressively denser network. Figure 3 is a copy of a drawing by William Bloom (formerly assistant to and now successor of Maximow) of one of these specimens of Maximow's. I wish to express my sincere thanks to Dr. Bloom for allowing me to use this picture, and also for giving me many valuable suggestions in conducting these investigations.

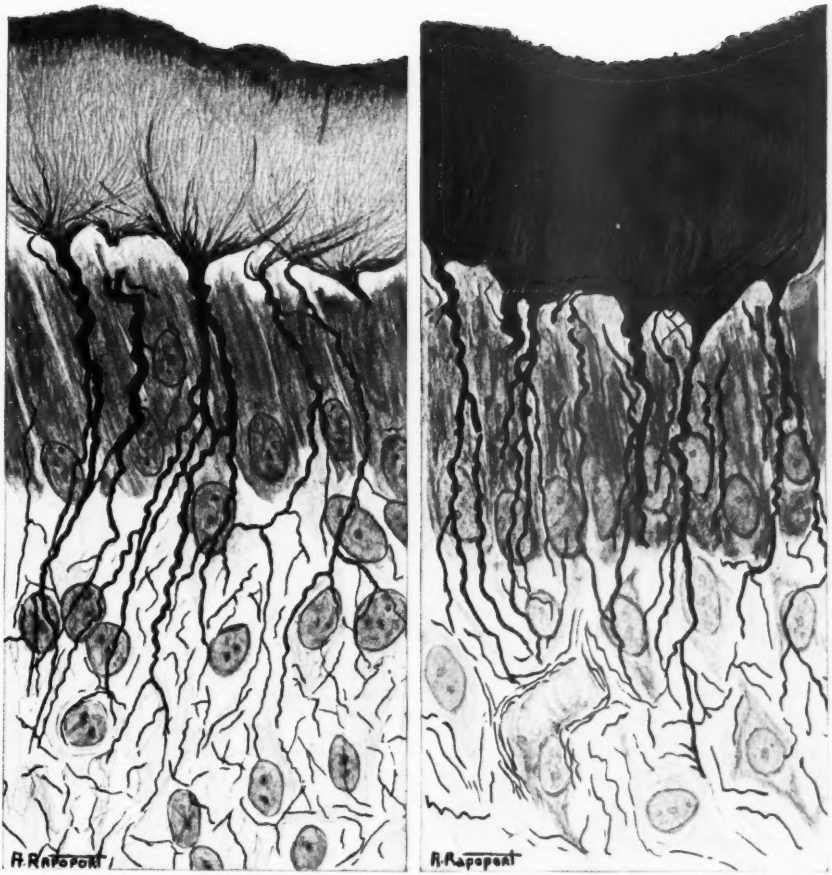
As the tissue cultures grew still older, the fibers came to be arranged in bundles, which grew thicker and became wavy in appearance. At the same time, they lost their argyrophil properties and became acidophilic. In silver solutions, they would become yellowish brown instead of black; in Van Gieson's solution, they would stain red, and in Mallory's, blue. In the whole culture, it was observed (Fig. 3) that the black fibers changed their character and stained blue or differently according to the method applied. In this transformation, they assumed the properties of true collagenous fibers. Maximow believed that the building process of the argyrophil fibers took place outside the protoplasm of the cells. The nature of this development seems to be a kind of crystallization or precipitation process. The original colloidal solution probably elaborated by the cells is transformed into a gelatin by an unknown process, probably of a chemical and physical nature.

An extensive study has been made by N. C. Foot on the chemical differences between the argyrophil and collagenous substances. He writes:

> What is reticulin? From the viewpoint of many of us, frankly agnostic: it is a possible forerunner of collagen, very closely

Left: Fig. 4.—Camera lucida drawing of a specimen treated with silver and gold impregnation and stained with hematoxylin-azure-eosin. (Pig embryo.) The dentin matrix is stained brownish red, according to its collagenous nature. Korff's fibers are argyrophilic, stained black. The odontoblasts and pulp cells stain blue. Some purple stain in the pulp matrix indicates its mucoid character. Note the formation of Korff's fibers by the grouping of fine argyrophil fibers of the pulp into thick bundles. At the dentinal end, the argyrophil fibers spread out, change their staining reaction and become collagenous fibers.

Right: Fig. 5.—Camera lucida drawing of a specimen treated with silver and gold impregnation and stained by Heidenhain's modification of Mallory's method (pig embryo). The dentin matrix is stained blue; the fibers of Korff are argyrophilic. The odontoblasts are purple-blue. (Compare with Fig. 4.)



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related to it, but chemically different; it might be oxidized, or hydrolyzed collagen, or collagen plus or minus some side chain, or an isomer of collagen. . . . Reticulin contains phosphorus. . . . From the point of view of the histologist any reticular connective tissue becoming black when impregnated with double salts of ammonia and silver is reticulin. . . . What is collagen? From the standpoint of the chemist: a substance with a somewhat variable chemical formula and hydrolyzed into gelatin on boiling with water over long periods. It contains no phosphorus. From the standpoint of the histologist, a tissue component that stains red with acid fuchsin and blue with anilin blue (disregarding its other staining characteristics) and is found in the white fibrous connective tissue.

Another investigator whose observations have an important bearing on our problem of dentin development is Hanns Plenk. He made an extensive study of the argyrophil fibers—their nature, development and function. He states that the argyrophil fibers develop outside the cells, and the cells produce the matrix in which the fibers develop. The argyrophil fibers are precollagenous fibers from which the collagenous fibers develop. Not all collagenous fibers, as Plenk states, develop from argyrophil fibers, for they may develop directly without first being precollagenous. This process seems to have something to do with mechanical functions. If the tissue is not under stress, as in the umbilical cord, no argyrophil fibers may be seen at any time in the development, only collagenous fibers being present. It is also important that if mechanical function is required, the argyrophil fibers may remain in this stage of development without being transformed into collagenous fibers.

Another contention of Plenk is that the development of the matrix for argyrophil fibers is not the property only of fibroblasts, but also of all kinds of mesodermal derivatives, such as fat cells, endothelial cells and muscle cells. Plenk also gives a short description of the argyrophil fibers in the pulp, explaining that Korff's fibers are argyrophil fibers. He does not enter into a discussion of all the questions on this subject, but another investigator from the same institution concerns himself with it. The paper of Lehnert, to whom Plenk refers, is due in the *Handbuch* of von Moellendorff, Vol. V., Part 2, but has not appeared to date. Plenk quotes a few statements of Lehnert, who came to the conclusion that von Ebner's statement claiming that Korff's fibers are "predentin" is correct. They are not fibers or fiber bundles, but only portions of predentin which are pushed forward between the odontoblasts toward the pulp. It is, Plenk states, of especial interest that in the Korff fibers we have an argyrophil matrix which most probably has no fibrous structure.

As mentioned in the beginning, there are abundant investigations reported in the literature. Everyone who expects to conduct investigations must refer to the original contributions. Many bibliographic references are added to most of the papers mentioned above; consequently, the literature should be easy to follow.

My investigation covered material taken from embryos of pigs and of young cats, dogs' teeth and erupted functioning teeth from adult human beings. The specimens were fixed in Zenker-formol (90 per cent Zenker stock solution and 10 per cent neutral 40 per cent formaldehyd). No glacial acetic acid is used. The specimens were cut in small pieces, and fixed from two to eight hours.

As the technic of preparing the specimens for this study is somewhat complicated, I shall describe it here so that any one may follow it.

TECHNIC

After fixation in Zenker-formol solution, the specimens are placed in running water for twenty-four hours. There are then two ways to proceed: (1) to decalcify the specimen and then embed it in celloidin, or (2) to embed it first and then decalcify it. Either method can be used. The methods of decalcification and of embedding do not differ in any way from those employed in other staining technics.

Decalcify the specimen in 5 per cent nitric acid. The time depends on the size of specimen (from two days to four weeks).

Place it in 5 per cent sodium sulphate to prevent shrinkage (twenty-four hours).

Wash it in running water for twenty-four hours.

Place it in alcohol, 50, 75, 96 per cent, absolute alcohol, again absolute alcohol and absolute alcohol and ether, for twenty-four hours each; celloidin, 0.5, 1, 2, 4, 8 per cent, from two days to one week each, depending on the size.

The specimen is now ready to mount and section.

The following procedure is a combination method and has been worked out by different men—Maximow, Bielschowsky, Maresch, Foot and others. To fix the sections on the slides, egg albumen must be rubbed on the slide the same as for paraffin sections. Take the section from the microtome knife using very little alcohol. Alcohol coagulates the albumen on the surface of the slide, and the section will not stick later. Press the section to the slide with fiberless filter paper (Schleicher and Schüll No. 575) and cover the specimens with oil of cloves until the sections are transparent (from five to twenty minutes).

Place the specimen in 95 per cent alcohol until the sections become opaque; in 95 per cent alcohol again for ten minutes; again in 95 per cent alcohol for ten minutes; in absolute alcohol for twenty minutes; in absolute alcohol and ether for twenty minutes (by this process the celloidin is removed from the specimens); in 75 per cent alcohol for ten minutes.

Remove the Zenker's sublimate from the specimens. (Ten per cent Lugol's solution is used for from ten to twenty minutes until the deposits are dissolved. Lugol's stock solution is: 2 gm. of potassium iodid to 100 parts water, 1 gm. of iodin.)

Place in sodium thiosulphate for five minutes, employing 10 per cent of a 5 per cent stock solution of the thiosulphate in distilled water.

Rinse the specimens three times in distilled water for five minutes each.

Remove the bichromate of the Zenker solution by using potassium permanganate (0.25 per cent) for five minutes, tap water for three minutes, 5 per cent oxalic acid for from fifteen to thirty minutes, tap water for five minutes, and distilled water for three minutes.

The sections are now ready for silver impregnation.

Place in a 2 per cent silver nitrate solution for forty-eight hours in a dark place.

Rinse the specimen in distilled water for five minutes.

Place in silver ammonium oxid solution for thirty minutes.

(It is very important to prepare a fresh solution carefully each time. Take 10 c.c. of 40 per cent sodium hydroxid solution. Add in drops, by shaking the glass, from 20 to 22 drops of ammonia water. Only a few particles of undissolved silver should remain at the bottom of the bottle, because, if it is all dissolved, the solution is not good and a new one has to be prepared. Use absolutely clean bottles. Filter the solution after adding the ammonia water and add to the solution enough distilled water to make 40 c.c. The specimens, as was said before, remain in this solution for thirty minutes.)

Wash in distilled water for five minutes; in 5 per cent formalin solution for thirty minutes; in tap water for five minutes; in 1 per cent gold chlorid solution for one hour.

Wash in tap water for five minutes; in 5 per cent sodium thiosulphate (as above) for two minutes; in tap water for two hours.

After the silver and gold impregnation is completed, the sections can be prepared for enclosing in balsam, but they can also be stained with other dyes for coloring the cell nuclei and the protoplasm. For this, various methods may be employed. I used Delafield's hematoxylin and azure II-eosin in some cases, and Mallory's stain in the modification of Heidenhain in others. Delafield's hematoxylin has to be used in a very weak solution (2 drops of stock solution to 100 c.c. of distilled water) for from ten to twelve hours. Then eosin-azure is used for twelve hours. For this, we have two stock solutions:

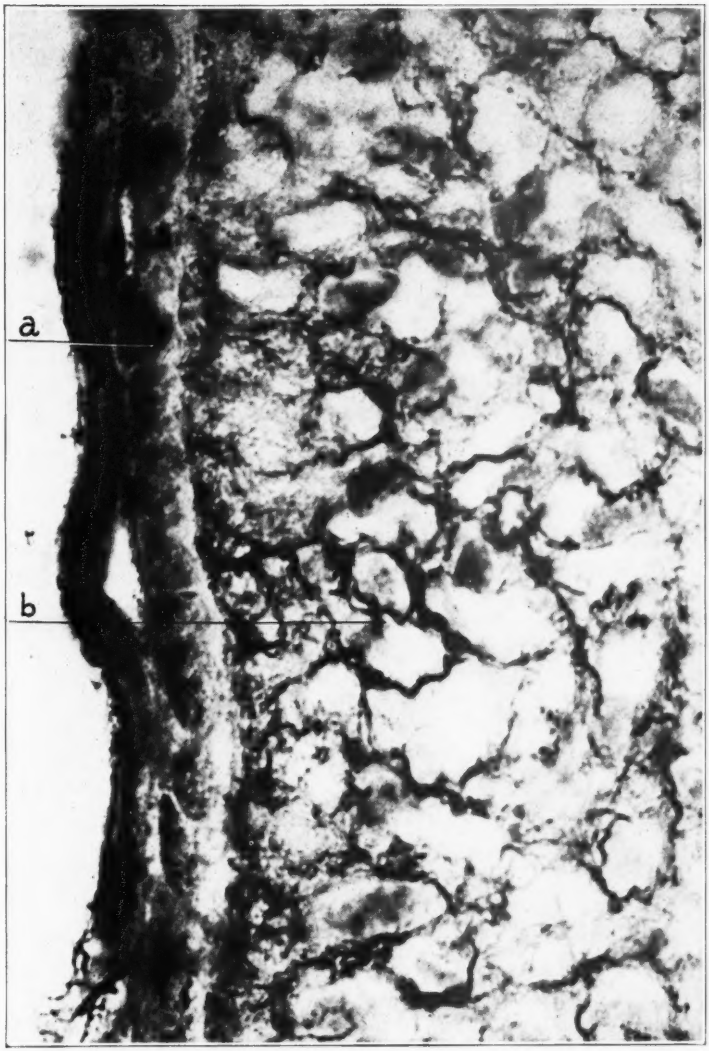

Fig. 6.—Hertwig's epithelial sheath (*a*) and pulp tissue (*b*) of a tooth of a pig embryo, treated by silver-gold impregnation. The location of the area in the tooth germ is given in the diagram Figure 7. The argyrophil fibers in the pulp encircle the cells and reach to the borderline of pulp and epithelium. (× 1,800.)

1. Eosin (water-soluble yellowish), 1 part to 1,000 parts water. 2. Azure II, 1 part to 1,000 parts water. Use 12 c.c. of the eosin and 9 c.c. of the azure with 100 c.c. of distilled water. (The eosin has to be added to the solution first.)

After the azure-eosin treatment, the specimens have to be placed in absolute alcohol for from five to twenty minutes to differentiate. Do not use lower concentrations of alcohol. Change the absolute alcohol once and place the sections in xylol (xylene). Change the xylol once, and after the sections are cleared, mount them in balsam.

If the Mallory-Heidenhain method is used after the silver and gold impregnation, place the sections in anilin alcohol for thirty minutes (1 part anilin to 1,000 parts 96 per cent alcohol). After this, the sections are placed in a 1 per cent solution of azocarmin G (boil the solution at time of preparing it and filter it), which is made acid with glacial acetic

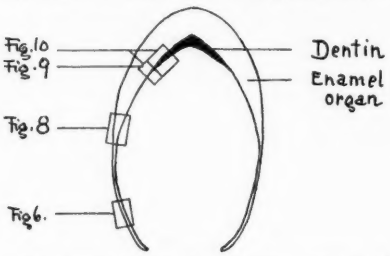

Fig. 7.—Diagram showing the location of Figures 6, 8, 9, and 10 in the tooth germ of a pig embryo.

acid, 1 c.c. of acid being used to 100 c.c. of the stain. (The solution must have an acid odor.)

The sections remain in this solution for from sixty to one hundred twenty minutes, at 56 C.

Rinse in water and differentiate in anilin-alcohol solution as used above.

Rinse the specimens in alcohol and acetic acid (1 per cent) for from one-half to one minute to remove the anilin.

Place in 5 per cent solution of phosphotungstic acid for from one-half to three hours, and leave until the connective tissue is pale.

Rinse in distilled water.

Place in Mallory's solution for from thirty minutes to three hours. (The stock solution is: anilin blue, 0.5 gm.; orange G, 2.0 gm.; acetic acid, 8 c.c.; distilled water, 100 c.c. Boil, cool and filter it. For use, take 100 c.c. of water and 100 c.c. of the stock solution. The sections should remain in this solution from thirty minutes to three hours.)

Rinse in water, for a very short time.

Differentiate in absolute alcohol, change the alcohol once, use xylol twice, then balsam, and cover.

With the first method, the cell nuclei stain light blue, the body of the cells blue, the collagen fibers brownish red. The second method stains the nuclei reddish brown, the body of the cells bluish-violet, the collagen fibers deep blue. The reticulum fibers are stained black by both methods.

Figure 4 is a drawing from a specimen treated with the silver-gold impregnation—hematoxylin-azure-eosin stain. It is a section of a tooth germ of a pig embryo 32 cm. long. The brownish red layer represents the dentin matrix. The cylindrical blue cells underneath this layer are the odontoblasts. The other cells are pulp cells. The black fibers running from the pulp toward the dentin are Korff's fibers. We see in this picture the difference between the color of Korff's fibers (black) and that of the dentin matrix, which is brownish red. Before we enter into a discussion of the different questions which arise on close study of this picture, I shall show a specimen treated with the second method described; viz., silver-gold impregnation and the azan stain (Heidenhain's modification of Mallory's method). Figure 5 is a section similar to that shown in Figure 4. The dentin matrix, instead of being reddish brown, is blue, but the fibers running from the pulp toward the dentin are black.

These staining reactions indicate that Korff's fibers are argyrophilic. From the knowledge gained from a review of the literature, we know that this finding is in correlation with that of other investigators. That Korff's fibers become impregnated with silver has been observed

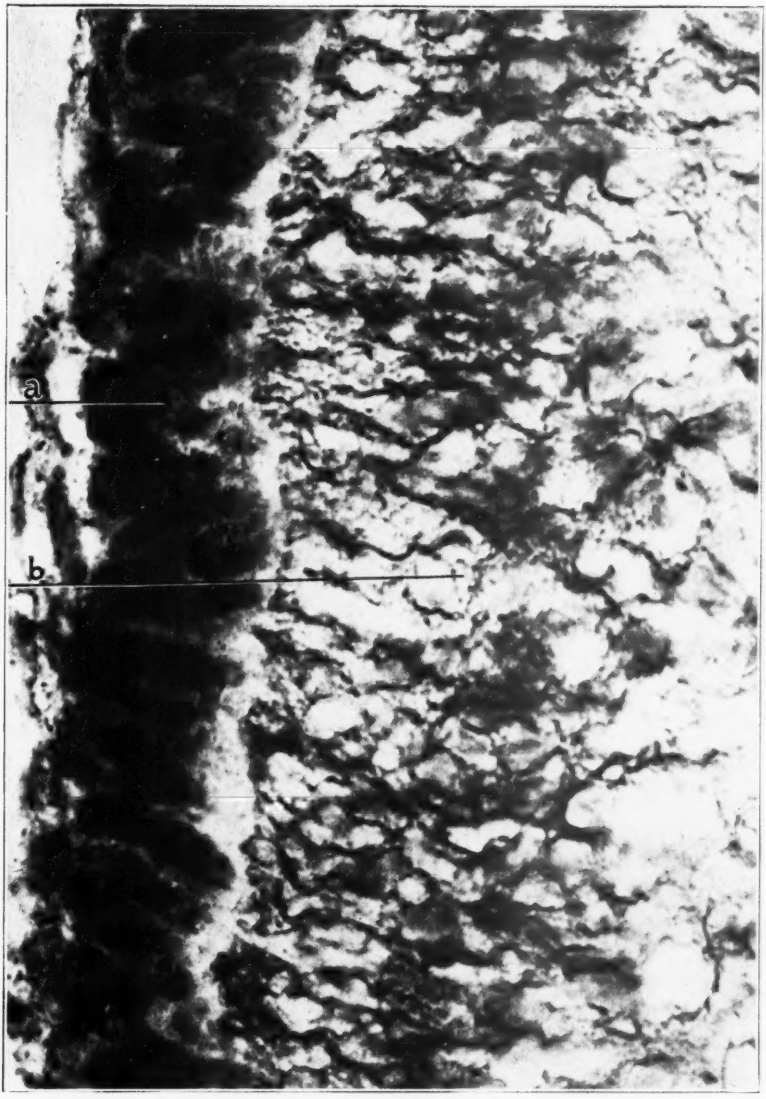

Fig. 8.—Hertwig's epithelial sheath (*a*) and pulp tissue (*b*) of a tooth of a pig embryo (silver impregnation). The location of the section in the tooth germ is given in Figure 7. The argyrophil fibers are arranged at right angles to the epithelium, forming at the borderline an interwoven membrane, the basal membrane. (× 1,800.)

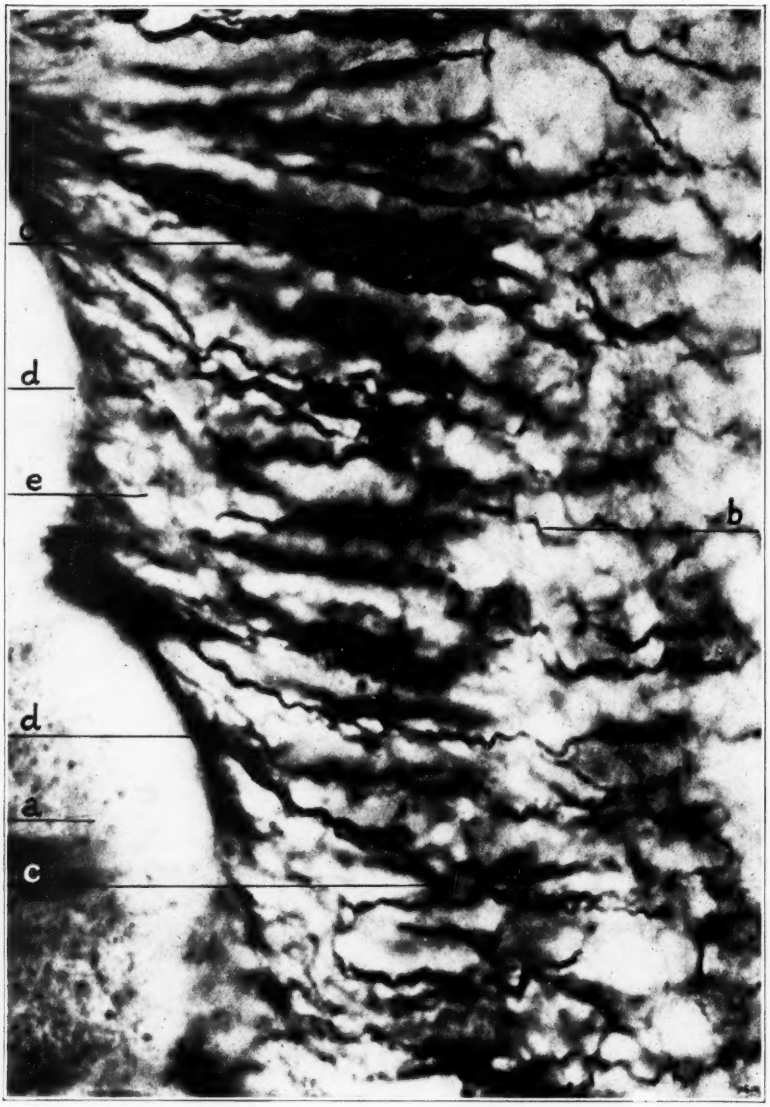

Fig. 9.—Area near the point where the development of the dentin starts. The argyrophil fibers become thicker and reach the borderline between pulp and enamel epithelium. (See Fig. 7.) *a*, enamel epithelium; *b*, pulp; *c*, Korff's argyrophil fibers; *d*, borderline between enamel epithelium and pulp; *e*, Korff's fibers indefinitely outlined. (× 1,800.)

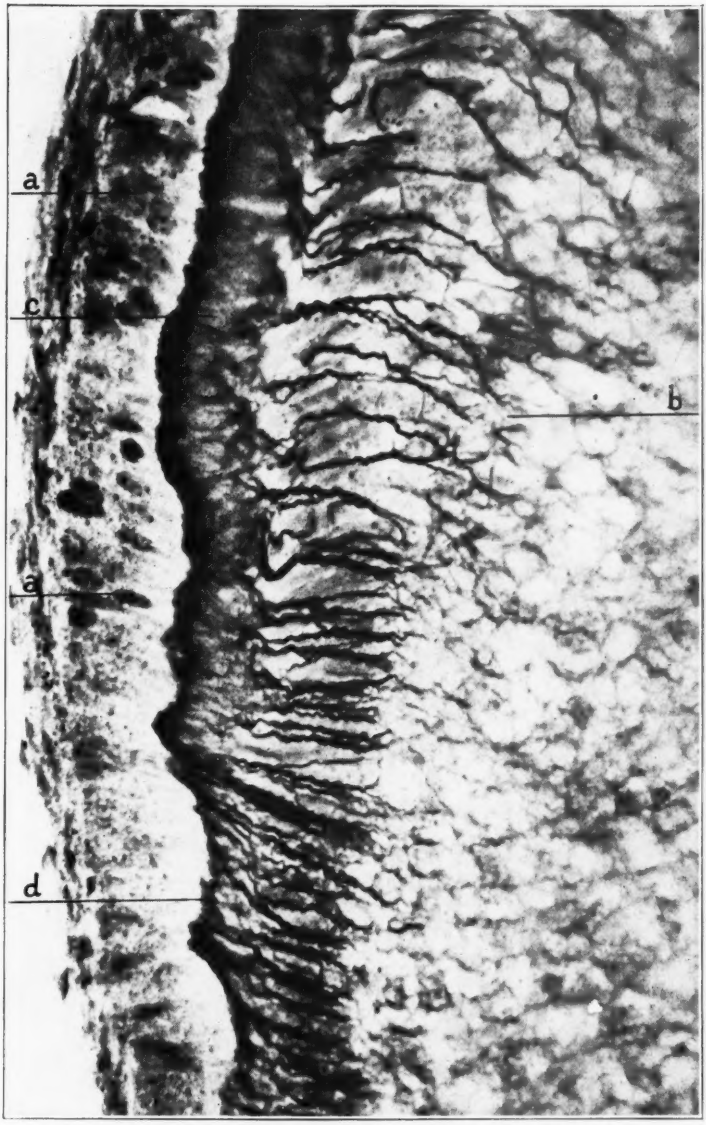

Fig. 10.—The dentin matrix developing from the argyrophil fibers (pig embryo). Figure 4 was made from this section. The drawing shows the colors in this specimen. *a*, enamel epithelium; *b*, pulp; *c*, dentin matrix; *d*, argyrophil fibers reaching to the borderline of epithelium and pulp. Area *d* has been shown in Figure 9. Note the wavy appearance of the outer borderline of the dentin. (× 720.)

Fig. 11.—Higher magnification of Figure 10. *a*, enamel epithelium; *b*, pulp with argyrophil fibers; *c*, branching of the argyrophil fibers in the dentin matrix. (Compare with Fig. 4.) *d*, collagenous dentin matrix. Note the fanlike spreading of the fibers in the dentin matrix. The outer layer of the dentin matrix is colored black. It remained argyrophilic, while the other part became collagenous. (× 1,100.)

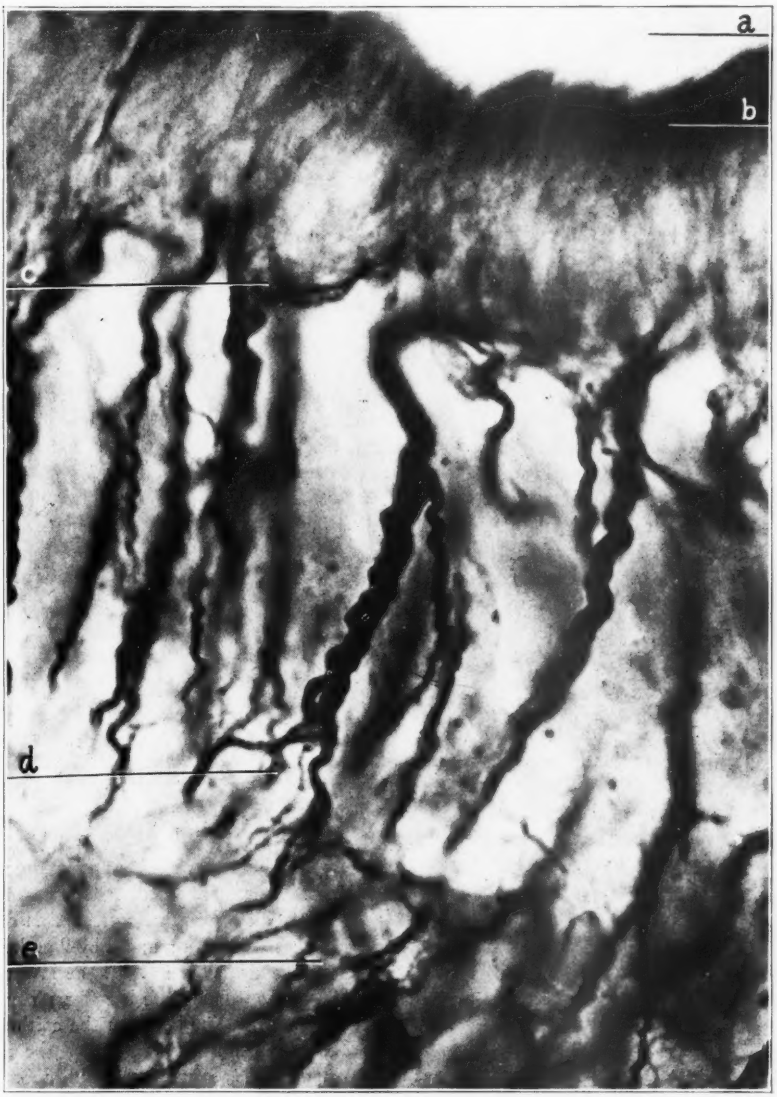

Fig. 12.—Higher magnification of Figure 11. *a*, enamel epithelium; *b*, argyrophil outer layer of the dentin matrix; *c*, conelike spreading of Korff's fibers; *d*, grouping of argyrophil fibers into Korff's fibers; *e*, argyrophil fibers in the pulp. (× 2,300.)

by von Ebner, Studnička and Plenk. The difference in staining between the argyrophil fibers and the collagenous fibers is due to some chemical difference corresponding to the statements of Foot. Korff's fibers are argyrophilic. According to this finding, we cannot prove the statement of Weidenreich, who, in his last paper on the subject, claims that Korff's fibers are true connective-tissue fibers. The expression "true connective-tissue fibers" has been used for collagenous fibers and cannot be used for argyrophil fibers.

It seems to be generally accepted that the argyrophil fibers are the forerunners of the collagenous fibers. Maximow observed the transformation of argyrophil into collagenous fibers in cultures of connective tissue. It also seems to be more and more accepted that the argyrophil fibers develop outside the body of the cells in the intercellular substance. The cells produce the intercellular substance and, owing to some kind of influence, probably chemical, the argyrophil fibers develop in this matrix. The embryonic pulp is very rich in argyrophil fibers. Figure 6 shows a specimen of a pig embryo with the argyrophil fibers in the pulp. The fibers encircle the cells of the connective tissue in an irregular arrangement, crossing one another and building a network. At the left side of the picture, we see the double layer of Hertwig's epithelial sheath. The argyrophil fibers end just below the epithelial layer, forming there a fibrous network. This photomicrograph depicts the region of the tooth germ indicated on the diagram Figure 7. If we follow the enamel epithelium toward the tip of the enamel organ (Fig. 8), we will find the ganoblasts (inner layer of the enamel organ) already developing. The cuboidal cells in the former picture are here somewhat elongated, and more nearly cylindrical. The argyrophil fibers of the pulp show a somewhat different arrangement. In the deeper part of the pulp, they still encircle the cells; but toward the enamel epithelium, they present a more or less radial arrangement. They end on the borderline between the epithelium and the pulp, forming a network. The fibrous membrane on the borderline of the epithelium and the connective tissue is called membrana praeformativa (Raschkow).

Still nearer the tip of the tooth germ (Fig. 9), just at the line where the dentin formation starts, we can see the argyrophil fibers running from the pulp toward the borderline of the epithelium. The fibers at this region are thicker, definitely outlined, corkscrew-like and wavy. They can be followed to the epithelium, where they form the membrane before mentioned. At the pulpal end, the fibers are in connection with the fibers encircling the pulp cells. At certain places, especially at *e,* we cannot follow the fibers quite clearly to the borderline of the epithelium and the pulp, for the outline of the fibers becomes indefinite, being somewhat pale. In the original specimen, we observe at this place a pale brownish red. The transformation of the argyrophil or precollagenous into collagenous fibers begins at this point.

A lower magnification of this area and of that somewhat nearer the tip of the tooth germ is seen in Figure 10. It corresponds to the area marked by *9* and *10* in the diagram Figure 7. At the lower end of the picture, we see the fibers running to the borderline between the epithelium and the connective tissue of the pulp. Further, we see the argyrophil fibers end at the borderline between the pulp and the dentin matrix. This specimen is the same as that from which the colored drawing Figure 4 was made. We can see

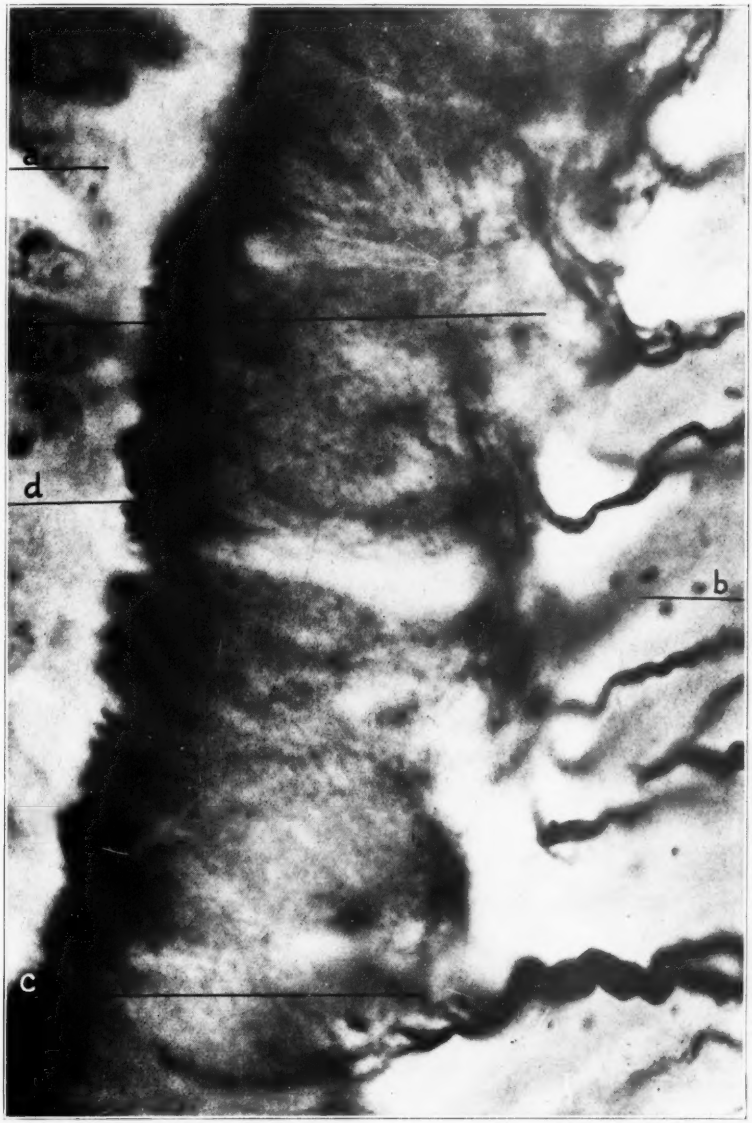

Fig. 13.—Higher magnification of Figure 11. *a*, enamel epithelium; *b*, odontoblasts; *c*, spreading of Korff's fibers in the dentin matrix, changing from an argyrophil into a collagenous matrix; *d*, argyrophil outer layer of the dentin matrix. (× 2,800.)

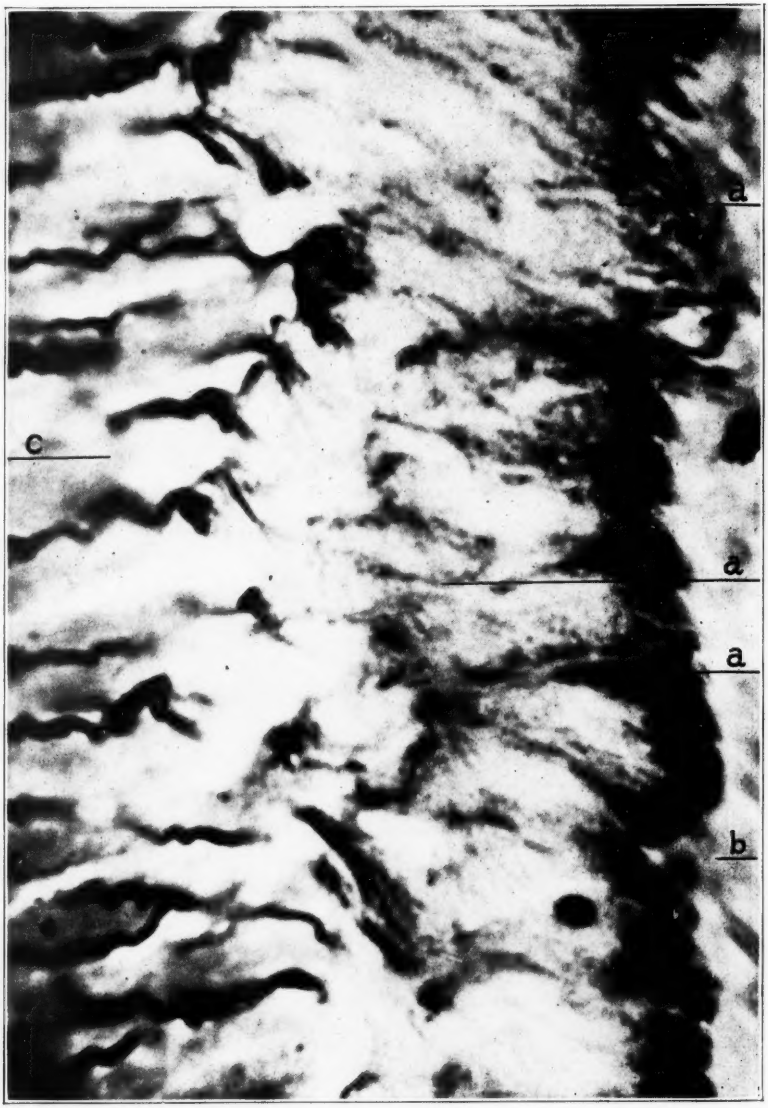

Fig. 14.—Specimen treated by silver impregnation and hematoxylin-azure-eosin (pig embryo). The dentinal tubules (*a*) are seen crossing the entire dentin matrix. The dentinal tubules are bordered by a black argyrophil matrix. This is probably Neumann's sheath. *b*, enamel epithelium; *c*, odontoblasts. Between the odontoblasts, Korff's fibers can be seen. (× 2,300.)

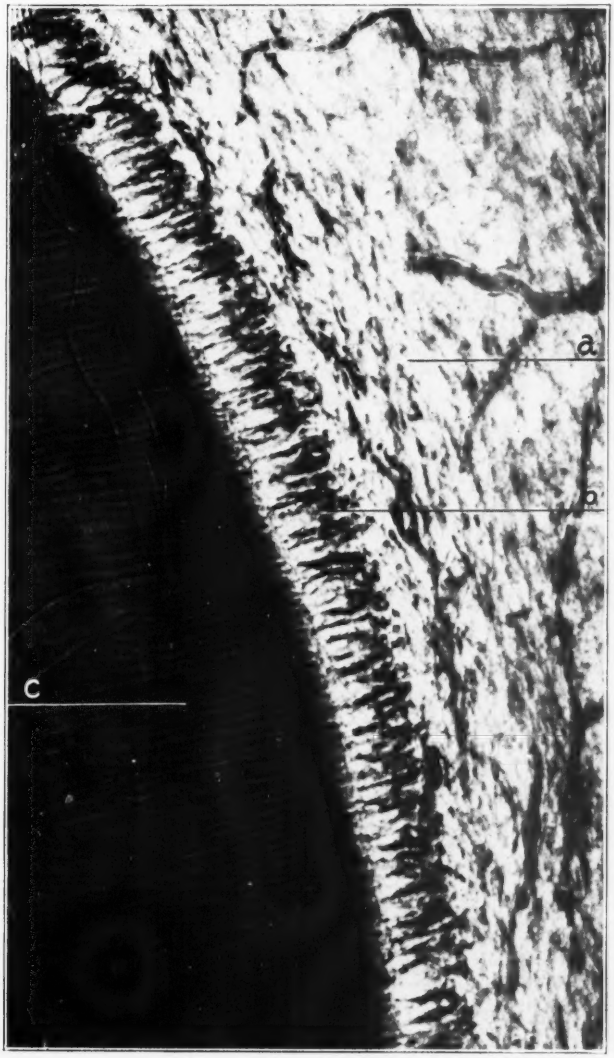

Fig. 15.—Pulp and dentin of an erupted deciduous tooth of a cat. This specimen is stained with hematoxylin-eosin. The odontoblasts are regularly arranged. No fibers are to be seen. *a*, pulp; *b*, odontoblasts; *c*, dentin. (× 340.)

in this photomicrograph how the argyrophil fibers surrounding the cells of the pulp become arranged at right angles to the outer surface and form thick bundles, Korff's fibers. This low magnification affords an excellent opportunity for the study of the arrangement of the fibers, their connections with the surroundings and their course. By using higher magnifications, we lose the view of these things, because the fibers and their branches lie in different planes in the sections. High magnifications give us the view of one plane at one time, while low magnifications show more or less the entire thickness of the specimen. The drawings in Figures 4 and 5 are made with a high magnification, and, during the drawing, the objective was focused to include the entire depth of the specimen. Therefore, in the drawing, all the branches of the argyrophil fibers can be seen, while, in the photomicrographs, some places are sharp and others indefinite.

The value of direct observation and reproduction in drawing has this advantage over the photomicrograph, because, during direct observation, different planes can be observed, while in photography only one plane is shown. This fact has been especially noticeable in the study and the reproduction of the endings of Korff's argyrophil fibers at the dentin. It has been stated by von Korff that the fibers as they enter the dentin spread out fanlike. This statement was questioned by von Ebner, who was not able to make the same observation. Moreover, von Ebner questioned even the fibrous nature of these structures, and claimed that they are homogeneous substances of predentin. This statement of von Ebner seems to have been confirmed by Lehnert (who is quoted by Plenk). My specimens favor the observation of von Korff. The fibrous nature of these structures is unquestionable. These fibers are collections of the fine argyrophil fibers of the pulp, and sometimes in high magnifications they can be followed from their beginning in the pulp to the dentin. They are interwoven with one another and form a thick trunk. In other cases, only the beginnings can be seen, and the thick trunk appears to be homogeneous. Every one of these thick trunks split into fine branches at the dentinal end. Figure 11 is a higher magnification of Figure 10. We can readily observe the structure of the fibers at the pulpal end. From some of the thick trunks, finer fibers branch off from their course and join the neighboring trunk or fibers.

Figure 12 is a still higher magnification. In this picture, we see very plainly how the thick trunks are built up by the collection of finer argyrophil fibers into thicker ones. At this magnification, we also are able to observe the dentinal endings of Korff's fibers. They spread out conelike as described by Korff, and split into fine fibers. A photograph cannot reproduce this splitting accurately because the fine fibers lie in different planes of the section. Only a few fibers can be seen at one time. Their arrangement is conelike and not fanlike. Figure 13 is a still higher magnification of Figure 11, showing only the dentin matrix and the endings of the fibers in the matrix. That the fibers in the dentin matrix cannot be seen so sharply as before entering the matrix can readily be explained. The fibers in the pulp are argyrophilic; they are black, and Korff's fibers especially are very thick. As they reach the dentin, they spread out conelike into fine fibers and change their chemical nature. They can be followed for a short distance only as black fibers, and then they become brownish red or blue according to the

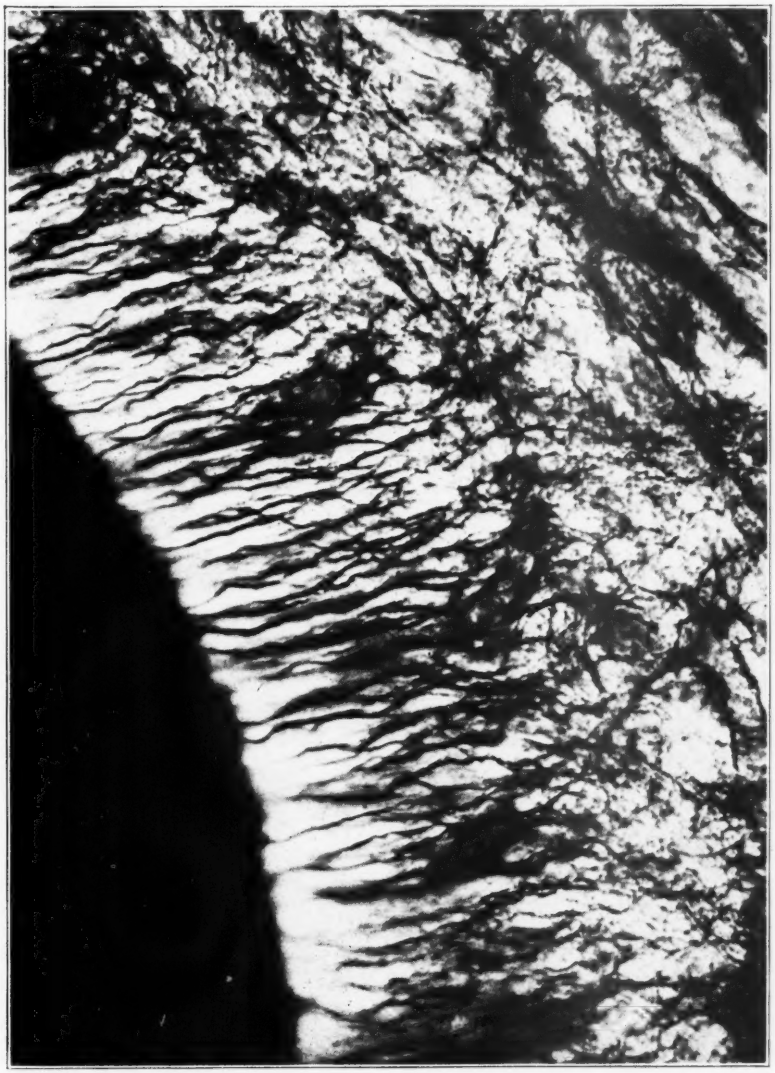

Fig. 16.—Pulp and dentin of the same tooth as that shown in Figure 15. This section has been impregnated with silver. The argyrophil fibers in the pulp and the argyrophil Korff's fibers are as clearly seen as in tooth germs. (× 700.)

Fig. 17.—Pulp of an erupted deciduous tooth of a cat. The argyrophil Korff's fibers are to be traced from the pulp to the dentin. *a*, Korff's fibers; *b*, pulp; *c*, blood vessel. (× 700.)

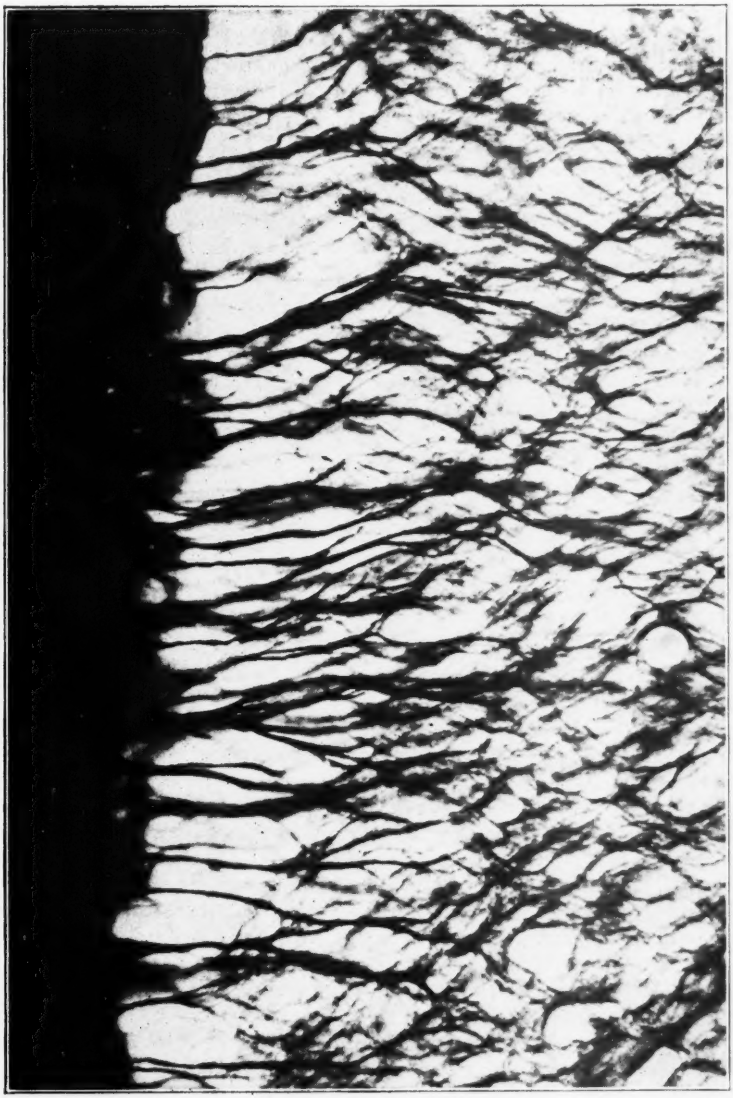

Fig. 18.—Floor of the pulp chamber of an erupted permanent tooth of a cat (silver impregnation). (× 700.)

counter staining method applied. They have become collagenous fibers. The collagenous fibers are very fine and not so distinct as the argyrophil fibers. In the deeper layers of the dentin, they are almost invisible because these are so closely packed. The dentin appears more homogeneous; however, its fibrous nature can always be recognized. The transformation of the argyrophil fibers into the collagenous fibers can be seen in Figures 4 and 5, in which we can observe the spreading out of Korff's fibers. The fine fibers are black as they go over into the dentin matrix, but soon lose their black color as they are transformed into collagenous fibers. The collagenous fibers in the dentin matrix run parallel to the outer surface or obliquely to it.

It is natural to suppose that not the fibers alone should form the matrix of the dentin. They are embedded in an interfibrillar substance, probably similar to that of the intercellular substance in the pulp. This intercellular or interfibrillar substance is the product of cells. In the beginning of dentin formation, when no odontoblasts are yet present (Figs. 6, 8 and 9), this interfibrillar substance is the product of the young fibroblasts of the pulp lying at its periphery. These cells most probably are those which later develop into the odontoblasts. In later stages, when the odontoblasts are developed, they, I believe, may contribute to the dentin formation by producing the interfibrillar substance. By means of the production of some chemical substance, the odontoblasts may have also the function of bringing about the changes in the nature of the fibers—the transformation of the argyrophil fibers into collagenous fibers.

After a discussion of the findings mentioned above, we observe that almost all the investigators mentioned have been right as to some of their findings but not in all. We can answer the questions asked at the beginning as follows: 1. The first matrix of the dentin is fibrous. (This answer is in agreement with von Korff, Studnička and Weidenreich, but not von Ebner. I am inclined to the opinion of Studnička, who describes the presence of an interfibrillar substance. However, I cannot enter into a discussion as to whether we can call this interfibrillar substance an "exoplasm" of the cells or not. The latest investigation seems not to be in accordance with this conception.) 2. The collagenous fibers of the dentin are produced by the transformation of argyrophil fibers of the pulp. The matrix in which the collagenous fibers are embedded seems to be a product of the odontoblasts and of other pulp cells. (This conception, in a slightly different mode of expression, favors the conception of von Korff, Studnička and Weidenreich, and somewhat refutes that of von Ebner.) 3. Korff's fibers are argyrophil fibers, precollagenous in nature. (This statement is in accordance with that of von Ebner and Studnička and not with that of von Korff and Weidenreich, who claimed that they are true connective tissue fibers; that is, collagenous.)

I cannot confirm the opinion of von Ebner that Korff's fibers are not fibers but a homogeneous mass. They are true fibers which are the result of a gathering together of the finer fibers of the pulp into thick trunks. It must be added that we cannot claim absolutely that the odontoblasts have nothing to do with the production of Korff's fibers. As Plenk stated, all kinds of cells of mesenchymal origin can produce the matrix in which the argyrophil fibers develop. The odontoblasts, being of mesenchymal origin, may possess the same properties; and it is

Fig. 19.—Pulp and dentin of an incisor of a 36-year-old human being; intact tooth. Numerous Korff's fibers may be noted. (Silver-gold impregnation.) (× 600.)

possible that the odontoblasts have something to do with the fact that Korff's fibers are so much thicker in the region of the odontoblast layer. However, this cannot be considered to be the main function of the odontoblasts. They may only support the other pulp cells in the production of these fibers.

Some other findings need mentioning at this point. We see in the photomicrographs as well as in the colored drawings that the outermost layer of the dentin is stained black, while the other parts are colored blue or reddish brown, this varying with the methods employed. It seems that at this place the transformation of the argyrophil matrix into the collagenous did not take place. The cause of this fact is unknown. It may be that the presence of the enamel epithelium on the surface of the dentin has something to do with it. It may be that this argyrophil substance at the outer border of the dentin is responsible for the fact that the fibers here are coarser, not so fine as those in the inner part of the dentin. In silver-gold-azure-eosin stained specimens, another observation can be made. (Fig. 14.) Korff's fibers can be seen with their conelike endings at the dentin. The dentin matrix at the outer border toward the ganoblasts is darkly impregnated with silver. We observe quite plainly in this specimen the dentinal tubules running from the odontoblasts to the outer borderline of the dentin matrix. The matrix of the dentin is stained reddish brown, while the odontoblasts and their protoplasmic processes in the dentinal tubules are blue. Dentinal tubules can be seen not only because of the color difference between the protoplasmic Tomes' fibers and the collagenous dentin matrix, but also because the borderline between the dentinal tubules and the dentin matrix is darkly colored everywhere in this picture. This borderline is just as argyrophilic as the outer layer of the dentin matrix.

The existence of a special sheath around the dentinal tubules has been repeatedly questioned by some investigators and positively affirmed by others. Some (von Ebner and Fleischmann) have claimed that Neumann's sheath is in direct connection with the innermost, last-produced layer of the dentin, and that this innermost layer (Koelliker's membrane) can be isolated, together with Neumann's sheath. Other investigators (lately, W. Meyer) could not confirm these results of Fleischmann and claimed that Neumann's sheath does not exist. Observing my specimens, I am inclined to think that a special membrane does not exist. What we find around the dentinal tubules as a sheath is an argyrophil dentin matrix which did not change its chemical composition to become collagenous. Whether this fact has something to do with the close proximity of the protoplasmic dentinal fibers, we cannot determine, but we see that an argyrophil substance is everywhere in proximity with cellular elements, at the outer border of the dentin toward the ganoblasts, and also toward the inside where the odontoblasts border the dentin. It is quite possible that the substance which Fleischmann and von Ebner could isolate as Koelliker's membrane is the argyrophil matrix at the inner borderline of the dentin which does not become transformed into a collagenous matrix. This inner argyrophil substance is in direct connection with the argyrophil matrix surrounding the dentinal tubules. I could not follow in my specimens what happens to this argyrophil matrix in the dentin during later developmental processes such as calcification. The entire theory about Neumann's sheath must be fur-

Fig. 20.—One of the neighboring sections of that in Figure 19 stained with hematoxylin-azure-eosin. Odontoblasts border the dentin. No Korff's fibers can be seen. (× 600.)

ther investigated from this point of view.

Before going farther into the discussion of dentin development, I should like to call attention to another finding in these specimens. In Figure 10, we saw the dentin in its first stage of development at the lower end of the picture. Higher up, the matrix of the dentin is already formed. The lower end interests us at this time. It is well known that the borderline of dentin and enamel, the dentino-enamel junction, is not a straight line but wavy or scalloped. The development of this scalloped line has been the topic of endless discussions. Such investigators as von Ebner and Walkhoff believed and claimed that this scalloped appearance is due to resorption of newly formed dentin substance by the inner layer of the enamel organ, the ganoblasts. This theory found its way into scientific papers as well as textbooks without having been supported by actual findings. With a background of actual data, I have been able to express firmly my convictions against this conception. I could show that this scalloped borderline of the dentino-enamel junction is formed before the dentin or the enamel is built, and so cannot be the result of resorption. This finding and statement also has been questioned by Münch, a pupil of Walkhoff, without the slightest foundation. Recently, Tylman found specimens favoring my observations. The section shown in Figure 10 is a further proof against the resorption theory and in support of my own. We see the scalloped appearance of the later dentino-enamel junction quite definitely outlined before the dentin and the enamel are formed. Korff's fibers run from the pulp to the borderline of the pulp and the ganoblasts, and this borderline is scalloped. No sign of the slightest resorption can be noted. The supposition that there is a resorption at this line is absolutely unfounded, and I hope that after this description the conception will disappear, at least from the textbooks. It has been claimed against my findings that the wavy appearance of the borderline between the pulp and the enamel epithelium before the production of dentin may be due to shrinkage in the specimen. It may be, but in many cases that I have seen, and shown, and certainly in Figure 10, this is not the case. We observe that the outer line of the ganoblasts is a straight line; it is not scalloped as the inner line is. If we should have a shrinkage in this case, the outer borderline of the cells would have the same appearance as the inner has. Without entering into further discussion, we see that the scalloped dentino-enamel junction is already indicated before dentin or enamel is built, and that this line has nothing to do with resorption.

The next question which arose during the discussion of dentin development was as to whether Korff's fibers were concerned with the entire development of the dentin (von Korff) or (as von Ebner stated) only with the beginning (corroborated by Studnička, Weidenreich and others). In addition to these investigators, we have, in the literature, reports of others on this question. Some of them report the presence of Korff's fibers in adult teeth; others deny it. Some claim that these fibers appear only in the irregular production of dentin under nonphysiologic conditions. In my studies, I paid special attention to this question, and came to the conclusion that the entire development of the dentin takes place in the same way.

In Figure 15, we see the odontoblastic layer in the pulp of a functioning deciduous tooth of a cat. The specimen is stained with hematoxylin-eosin. No fibers whatever can be seen between the odon-

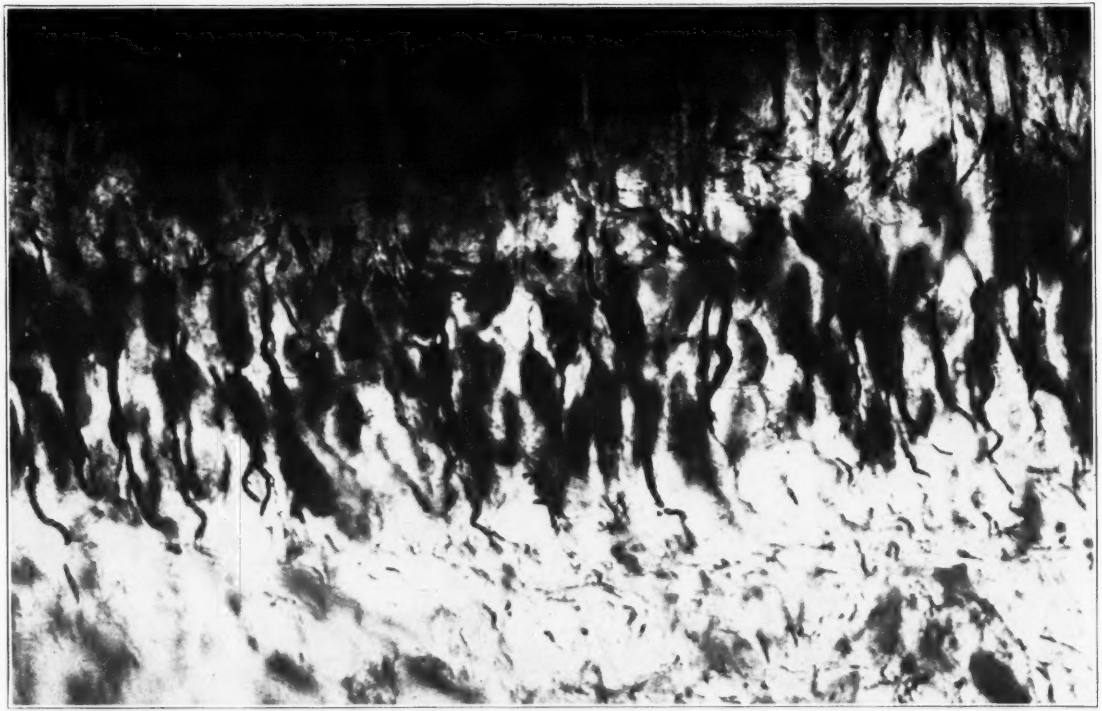

Fig. 21.—Pulp and dentin of a bicuspid of a 40-year-old human being; intact tooth. (Silver-gold impregnation; azan stain.) Numerous argyrophil Korff's fibers can be traced between the odontoblasts to the dentin. The collagenous (blue in the specimen) fibrils in the dentin matrix are clearly visible. (× 1,100.)

toblasts. The next section in the series of the same specimen has been impregnated with silver, as described before (Fig. 16). Korff's fibers can be seen in great numbers. Some investigators claim that sometimes Korff's fibers occur in adult pulp only, but that they are so few that they are inconsequential. The specimen in Figure 16 shows that in deciduous, erupted and functioning teeth of cats, we find Korff's fibers in great abundance, just as in developing tooth germs.

Figure 17 is also a specimen of a deciduous tooth of a cat. This section is only impregnated with silver. No gold chlorid or any stain has been used for the cells. We can see the fine argyrophil fibers in the pulp, their gathering into thick trunks and their fanlike spreading in the dentin matrix. I have observed similar findings in dogs' teeth.

Figure 18 is a section of an erupted permanent tooth of a cat. The great abundance of the argyrophil fibers speaks for itself. It should be noted that, in the last two specimens (Figs. 17 and 18), the argyrophil fibers are not so wavy as they have been in the former cases.

Some investigators have objected to the use of animal teeth for the investigation of dentin development. It has been claimed that the teeth of small animals such as cats, dogs or rats develop much faster than those of human beings, and that the development, being rapid, cannot be compared to that of human dentin, which proceeds slowly. It has been stated that if, in human teeth, the dentin development occurs rapidly, as in the irregular production of dentin, Korff's fibers are present. This comparison between irregular rapid production of secondary dentin in human teeth and the rapid growth of animal teeth does not seem to me very logical. No argument is so valuable as actual findings; consequently, I shall present my findings.

Figure 19 is a section of an incisor of a human being, aged 36 years. The tooth was intact, showing neither caries or fillings. It had been extracted for prosthetic purposes. All the human teeth shown here have been handled in the same way. After extraction, the apex was cut off with forceps, and the tooth dipped into the Zenker-formol mixture. The side parts of the tooth—the crown as well as the root—were ground down all around the tooth, so that only a very thin layer of dentin covered the pulp chamber and the canal. This procedure takes but a few minutes and is employed for two reasons: first, the fixation solution penetrates much faster into the tissues; secondly, decalcification can be brought about in less time. These teeth were embedded first in celloidin and then decalcified. Figure 19 is a section of the abovementioned tooth impregnated with silver and gold. No other stain was used. The wavy Korff's fibers can be clearly seen along the wall of the dentin. The fibers are not straight, but oblique and bent in their course. Their connection with other argyrophil fibers in the pulp is clearly seen.

Figure 20 shows another section of the same specimen, and the same area in the tooth, stained with hematoxylin-azure-eosin. Only the odontoblasts can be seen. There is no irregular production of dentin in this case. Everything in this pulp is normal.

Another case is shown in Figure 21, taken from a bicuspid of a 40-year old human being. The tooth was absolutely intact. This section was treated with silver-gold impregnation and the azan method. In the section, the dentin is blue, the cells bluish violet, the nuclei red and the fibers black. By focusing

Fig. 22.—Pulp and dentin of an incisor of a 40-year-old human being, impregnated with silver. A great number of Korff's fibers enter the dentin matrix. (× 850.)

the microscope, a great number of fibers can be seen. We observe also the spreading out of the fibers in the dentin, where they are stained blue because of their collagenous nature.

The section shown in Figure 22 originates from an incisor of the same individual as that in Figure 21. This section has been treated with silver only. We observe a large number of wavy argyrophil fibers which originate from fine argyrophil fibers of the pulp and at their dentinal end spread out into the dentin matrix. The dentin matrix in this specimen has a brownish color which is characteristic of a collagenous matrix that has been impregnated with silver alone. In the dentin matrix in this picture, as well as the former, the regularly arranged dentinal tubules can be seen as characteristic of the normal regular dentin structure.

These pictures, I believe, are demonstrative enough to prove our conception of the development of the dentin in later stages of life also. The argyrophil fibers play the same rôle throughout the life of a tooth. They form the collagenous fibers of the dentin by transformation of their structure and chemical nature.

In pathologic conditions or under the influence of irritation, we see dentin developing without odontoblasts. This dentin we call irregular or secondary dentin. It is not surprising at all that this dentin can form. The fibers are always present where connective tissue is present, and intercellular substance is present at the same time. There is little difference in the structure of the matrix of normal and irregular dentin. The main difference lies in the presence of the odontoblastic processes. One specimen of secondary dentin production is shown in Figure 23, originating from a molar of a 25-year-old human being with a chronically inflamed pulp. Other specimens from the same case have been presented by Dr. Coolidge in THE JOURNAL. In this paper also can be seen the production of dentin without odontoblasts. (See his Fig. 7.) The odontoblasts in this case have been trapped in the dentin matrix itself, and we see only a fibrous matrix without the presence of the odontoblastic processes. In Figure 23, we observe numerous fibroblasts in the pulp tissue. The dentin shows the dentinal tubules and Tomes' fibers inside them. The pulpal side of the dentin is a fibrous matrix without odontoblastic processes in it. The fibrous matrix goes over the fibers of the pulp without a sharp borderline. The dentin matrix is produced in this case without odontoblasts by the fibers of the pulp and the common fibroblasts in the pulp. As some of my specimens indicate, the fibers in irregular dentin production are not always argyrophilic, but, according to their staining reactions, are collagenous. The matrix between these fibers calcifies directly, giving rise to secondary dentin. These different modes of dentin development are to be further investigated.

Two more pictures, illustrating the same thing by different methods, are to be discussed before closing this presentation.

Figure 24 is a section of the borderline between the pulp and the dentin of a normal intact human tooth. The section runs in an oblique direction, as indicated in the diagram. By cutting in this way, we get an oblique cross-section of the dentin, and the borderline seems to be longer. This section has been impregnated with silver only. By this method, the argyrophil fibers stain black; the collagenous matrix of the dentin, brown. In photographing this section, I

Fig. 23.—Pulp and dentin of a molar of a 25-year-old human being. The pulp was chronically inflamed. There is production of secondary dentin (*c*) without odontoblasts, by the fibers of the pulp (*b*). *a*, dentin. (×900.)

used a yellow filter (Wratten M Filter G. No. 15) so that the brownish dentin matrix appeared light, while the argyrophil fibers appeared black. In the upper right corners of the picture, we see a black fibrous structure. This is an oblique cross-section through the region where the argyrophil fibers enter the dentin, spreading out conelike. The cells are located between the black fibers. The round spaces are the spaces for the odontoblast processes, the dentinal tubules. Toward the left lower side of the picture, the fibrous matrix of the dentin turns pale. The fibers cross one another, interweave and leave enough space only for the dentinal tubules. This picture is a very fine illustration of the gradual transformation of the argyrophil into collagenous fibers. Figure 25 is a similar section treated in a different way. It is impregnated with silver-gold and afterwards stained by the Mallory-Heidenhain method. The cells are bluish violet, and their nuclei are red. The fibers between the cells are argyrophilic. A blue filter (Wratten M Filter C. No. 49) has been used in photographing this section. The result was that the collagenous dentin matrix stained pale blue in contrast to the black argyrophil fibers. The fibrous nature of the dentin is quite evident, and the gradual change of the argyrophil into collagenous fibers is quite striking.

My present investigation permits the foregoing conclusions but does not permit further discussion of details. The nature of the argyrophil fibers, their development, their transformation into collagenous fibers, etc., are all questions widely discussed by many of the most eminent histologists. My aim has been to employ the newest methods and to correlate the findings obtained with our general knowledge.

CONCLUSIONS

1. The first matrix of the dentin is fibrous.

2. The fibers in the dentin are collagenous fibers which are embedded in an interfibrillar substance (called also cementing or ground substance).

3. The collagenous fibers of the dentin matrix are the result of a chemical transformation of argyrophil fibers into collagenous fibers. The interfibrillar or cementing substance is most probably the product of the odontoblasts and also other pulp cells.

4. Korff's fibers are argyrophil, precollagenous fibers.

5. In irregular production of dentin, collagenous fibers may directly form the matrix of the dentin without first being argyrophil fibers.

6. Neumann's sheath is not a separately produced structure. It seems that the borderline of the dentin matrix, wherever the dentin is adjacent to protoplasmic structures (ganoblasts, Tomes' fibers, odontoblasts) remains in a more primitive form of development; which means that it remains argyrophilic while the other matrix turns into collagenous.

7. The scalloped dentino-enamel junction is not the result of resorption, but is already so defined at the beginning of development.

8. The fibers of the pulp as well as the cells play the same rôle during the entire development and growth of the dentin.

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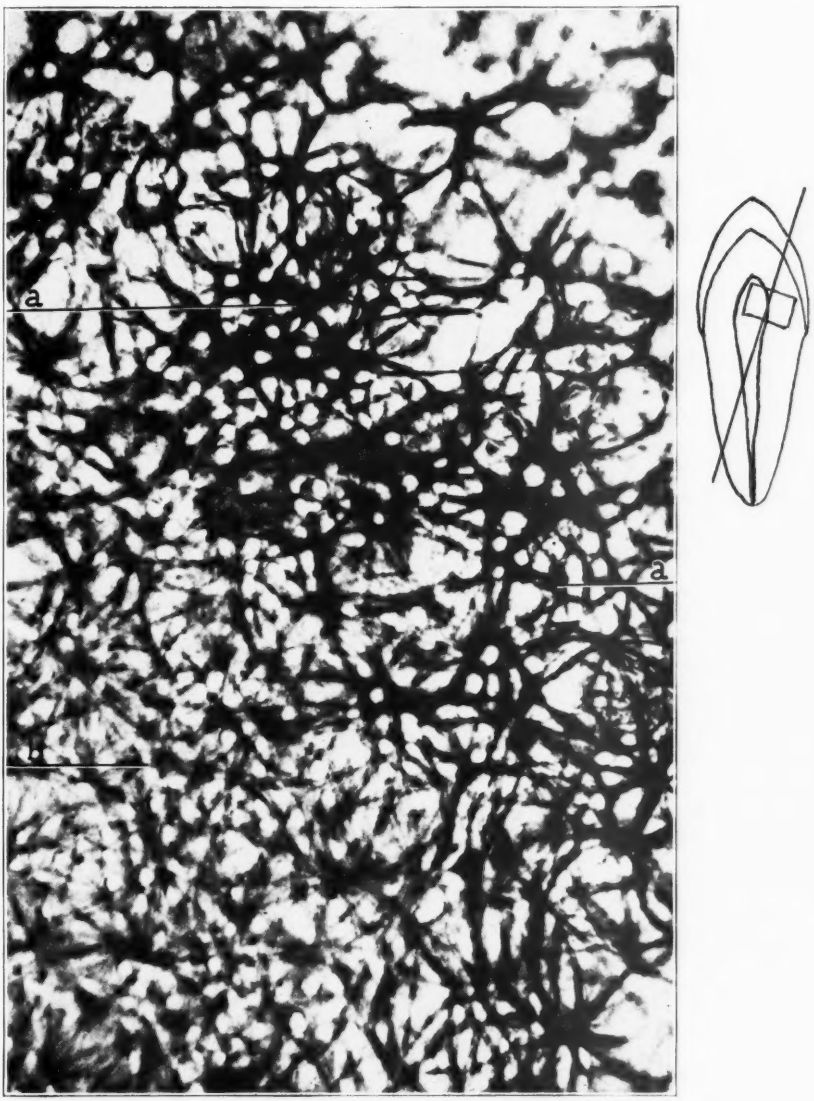

Fig. 24.—Oblique section at the borderline between pulp and dentin, as shown in the diagram to the right. By this oblique section, the network of argyrophil fibers as well as the dentin matrix can be seen. The section is impregnated with silver. The argyrophil fibers are black; the collagenous matrix is brown. The photograph was taken with a yellow filter, which gave the resulting black argyrophil and pale collagenous fibers. The fibrous nature of the dentin matrix is clearly to be seen, and the connection between argyrophil fibers and collagenous fibers is evident. *a*, argyrophil fibers; *b*, collagenous matrix of the dentin. (× 950.)

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Fig. 25.—Section taken in the same direction as that in Figure 24; treated with silver-gold impregnation, and Heidenhain's modification of the Mallory stain. The argyrophil fibers are black, and the dentin matrix is blue. The photograph was taken with a blue filter, with the result that the argyrophil fibers are black and the dentin matrix is pale. *a*, argyrophil fibers; *b*, collagenous matrix of the dentin. (× 1,200.)

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THE ORTHODONTIC PROBLEM AND OUR SCHOOLS*

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THE fostering and control of dental education belongs to the university and the closely allied educational bodies, and not to commercial or privately operated organizations. This remark, which may seem commonplace, forms, with the several paragraphs to follow, a preamble for my paper.

Many members of our teaching profession, and particularly those who possess a deep sense of ethical standards, have been annoyed by the accusation that the schools have failed to teach "business methods," or perhaps, to state it more abruptly, we have failed to tell the student how to charge and how to make money. There is a certain amount of

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justification in this criticism, but there is also a defense to be offered for the schools: Should we teach business methods or should we try to inculate ethical principles in the minds of our students? At any rate, the condition exists, and along has come the commercial teacher who finds the stage all set and an eager audience waiting for him to tell his story of business methods or principles—whichever you wish to call it. The discriminating dentist is able to select the good things from these "economic" lectures and apply them to his daily work. Both patient and dentist may profit thereby, but as we are not all of the analytic type, an evil creeps in. It would be far better for the nondiscriminating man who fails to separate the good from the bad in this commercialized instruction had he had business principles drilled into him while he was a student in college. Regardless of all this, it remains a fact that most schools are at fault for not teaching more of this sort of thing. Commercial interests have seen their opportunity and are making the most of it. Some dentists are delighted with their newly acquired wisdom and others are chagrined at the breach of teaching ethics.

And now a parallel: Several large commercial laboratory interests are organizing orthodontia departments with well thought out plans, carefully selected staffs, skilled technicians, trained salesmen, etc., to flood the land with orthodontic propaganda. The character of this propaganda will be alluring, and many a dentist will be enticed into using these laboratory devices and appliances, with the inevitable result that innocent young children will be subjected to a course of orthodontic (?) treatment barely short of malpractice.

These trained, high pressure salesmen will tell us that the diagnosis, the outline of treatment, the appliances, etc., have all been made by experienced, qualified, licensed dentists, and all that, but the trouble is with the practitioner. He will make his contribution to the manufacturer and he will also make a contribution to dentistry and orthodontia in the shape of a "failure," because he will not know what to do with the "outfit" after receiving it. We have failed to teach him the whys and wherefores of this fundamental dental subject in his student days.

The laboratories have heard the call of the public for more orthodontic service and, being good business men, they have acted, while the schools have allowed the teaching of this subject to drift idly with the current.

THE PURPOSE OF DENTAL EDUCATION

The statement and arguments that I present may, at first, seem contradictory, but they are paradoxical, as I shall try to prove. In establishing my premise, let me say that there is much fabric finding its way into our general dental curriculum which should be deleted, and other material should be woven in its place.

I contend that the primary purpose of dentistry is, or should be, the prevention of dental disease, and therefore our teaching should have that thought in mind. The student should be impressed with the idea that prevention is the important angle in his education and that repair or correction are but a means to an end, and, therefore, we should teach those things which tend to raise the resistance of the oral tissues, or better still, of the whole body, to a point of lessened frequency or immunity. These should be the paramount issues.

In the recent past, much effort has been directed toward refinements in rep-

arative methods. We would not in any sense belittle the enthusiasm of those who have given so freely for the advancement of the technical phases of dentistry, but it must be admitted by thoughtful educators that there has been a tendency to overload some departments of the curriculum with technic and details, to the extent of crowding out the fundamentals in other departments, some of which at least are the very foundation of dental practice.

The college considers its obligations fulfilled when the student leaves its portals well grounded in fundamentals, and likewise the school has fulfilled its duty to the public when the student is equipped to render a reasonable service in the needs of relief and repair. The universities realize this inadequacy in perfection, and that is the reason that postgraduate and graduate courses are planned for the promulgation of advanced learning. We should not try to make a specialist of the undergraduate, and, what is more, we cannot. Still, I believe that the educators must look the orthodontia teaching problem squarely in the face, and, without further parley, boldly declare that it should have its proper place as a major subject in the dental curriculum. If we look on orthodontia as a preventive measure, its importance supersedes even that of operative dentistry.

Dentistry was originally classed as a mechanical art having to do with the replacement or repair of the teeth. Gradually, experience has guided us to a greater appreciation of embryology, histology, anatomy, physiology, pathology, etc., showing us that prevention is much more important than repair. Dental science has taken on a newer and finer mantle with much higher aims; indeed, to such a degree that some people think dentistry should be separated into numerous subdivisions to be taught and practiced as such. However, it remains a fact that until such time as prevention supersedes disease, reparative measures must be practiced. As long as these measures must be practiced, they should be included in the general term "dentistry" and be taught in the dental curriculum, unless the entire status of dental education is reorganized.

ORTHODONTIA

So with orthodontia, born out of mechanics, developed rapidly through refinements in mechanical devices for tooth movement, developing an increasing appreciation that mechanical principles alone were insufficient to correct malpositions of teeth and maintain them in other positions, until now, we find dentists who would actually divorce orthodontia from dentistry, or, at least, from the undergraduate dental curriculum and teach it solely as a separate science. Again it remains a fact that orthodontia is a branch of dentistry; therefore, its fundamentals should be included in the curriculum of the dental school.

Orthodontia was the first and is admittedly the most independent specialty of dentistry. Such a statement is not intended to convey the impression that the science has reached its zenith. There remains a vast area to be opened up, to be developed and to be proved before the fullest attainment as an independent specialty in the field of health service can be claimed.

Let me repeat that we do not advocate making orthodontia specialists of the undergraduate, but we do advocate his being taught the underlying principles of the art, science and practice to the extent that he may reasonably serve humanity and counsel wisely with his

clientele. It is in this manner that the future dentist will do much to prevent the development of the glaring cases of malocclusion to be seen on every side and in every walk of life.

PRESENT-DAY NEEDS

Perhaps the greatest present need in the field of orthodontia is a complete revision of teaching methods. This at once implies the equipment of more men for teaching so that the work can be carried on in accord with the ideals of the leading orthodontists and such schools as are now giving comprehensive instruction. Orthodontic instruction as it is now being carried on in the majority of schools is wholly inadequate. There is an urgent need for research in orthodontic problems, and the standard of practice must be raised from an empiric effort as is apt to be the case when it is done by those poorly prepared to a systemized intelligent routine.

Because of the nature of these advances, progress will have to be gradual, and it would seem that the first requirement is the establishment of suitable graduate courses to supply the added teachers. These advances cannot be made without considerable financial involvement and therefore it seems that the larger and stronger universities or endowed institutions should be the ones to undertake the establishment of the graduate courses. The clinical advantages afforded by the larger cities is another point to be considered in this connection.

There is no reason why the young graduate of the future should not be prepared to practice preventive orthodontia, or, as Dr. Willett of Peoria, Ill., calls it,[1] to practice "intercepting malocclusion." Neither is there any just reason why modern schools should longer tolerate a compromise course in this subject.

Malocclusion is an increasing malady with far-reaching evil results. If the student (and family dentist, too, for that matter) should be taught only to recognize and eliminate the evident causative factors, he would be in position to render a greater service to children than a dozen orthodontists combined can render later in life. But teaching "recognition and elimination of the evident causative factors" has not been the vogue: it has been a case of "the cart before the horse," for treatment of well established malocclusion has been the mistaken concept to be carried out, rather than teaching the underlying principles. This has been particularly true in the clinical department. So, with inadequate fundamentals, equipment, teachers and curriculum, the teaching has been a failure.

We will pass discussion of the many beneficial results gained from orthodontic treatment and stress for the moment, the necessity for more orthodontic service and, consequently, the necessity for more and better orthodontic teaching.

Twenty-five years ago, it was said that 40 per cent of children's teeth needed straightening. Then, the estimate was raised in our literature to 50 per cent, then to 70 per cent, and, two years ago, Frank A. Delabarre, of Boston, stated that 90 per cent of the children's mouths examined in Forsyth Infirmary presented established malocclusion.

There are no accurate figures available setting forth the proportion of cases of school-age malocclusion that are being treated. The number is insignificant—probably less than 1 per cent and, next to dental caries, malocclusion may be considered nature's greatest malady.

1. Willett, R. C.: Intercepting Certain Types of Malocclusion, J. A. D. A., 16:389 (March) 1929.

The number of dentists even reasonably skilled in this branch is wholly inadequate to cope with the situation; the number of orthodontic teachers is insufficient; there are not enough graduate schools for this work, and, with one or two exceptions, there are no large clinics where the student and public may profit from thorough teaching and clinical practice. It is intimated that something must be wrong in the administrative policies of our educational institutions. Why have we been indifferent to this important branch of dentistry? I shall not undertake to answer that question now, but it may well be mentioned that the fault has not been entirely with the schools, for there are experienced orthodontists, too, who have been remiss in this matter of teaching. The alibis of the past should no longer hold—the future status of dentistry demands a rejuvenation in orthodontic education.

It has been said, time and again, that the undergraduate is not qualified to carry on exacting orthodontic work in the clinic (we perhaps will have to admit that point in view of the past teaching), but this is almost ludicrous when we parallel it with his early clinical experiences in other lines, such as painful cavity preparation, deep-seated caries, pulp extirpation, root canal treatment, extraction and preparation of abutments. Remember, these are branches in which he has been drilled both in theory and technic for a long period, and we would not think of excluding these subjects from the curriculum. The short lecture and laboratory course of the past in orthodontia is hardly comparable. It is no wonder that orthodontic teaching of the past has been a failure in view of the accepted teaching of the past.

The orthodontia course will continue to be a failure and a blot on our schools until given the same consideration as the other clinical branches. I may seem dogmatic, but I contend that orthodontia should be given—I hesitate and watch your reaction—the most prominent position in the entire dental curriculum, for the very foundation of orthodontia is occlusion, and occlusion is the foundation of all dentistry. I should like to inject right here the thought that we must think increasingly in terms of children's dentistry.

I realize that up to this point my presentation has not been in full accord with the aims of this body, and for this I apologize. It has not been a paper on teaching but rather an argument for more and better teaching of this neglected subject.

I shall outline briefly what I believe should be included in this course of study, and it is a pleasure for me to say that the university and school (Northwestern) which I have the honor of representing stands squarely upon a platform for a major course in orthodontia throughout the entire course of study.

May I, before outlining a course, present this one paragraph, purely a personal opinion but nevertheless with a bearing: I believe that, in the not too far distant future, there should be a renaming of the important branches of dental teaching, with a revised allocation of subjects. The thought, without mentioning the relative importance of topical headings, embraces subject headings or departments:

1. Dental pathology, including causes and medicinal and surgical reparative measures; usually comprehended in the terms "operative dentistry" and "oral surgery."

2. Oral prosthesis, including what is usually comprehended in "prosthetic

dentistry," "partial denture and crown and bridgework."

3. Medical sciences, including anatomy, physiology, pathology, biology, bacteriology, embryology, histology, chemistry and other collateral sciences.

4. Dental technology, including physics, engineering and mechanics; being an extensive course in the freshman year of all general dental technical procedures with special application in subsequent years in the form of short intensive laboratory courses.

5. Orthodontia, the science of occlusion of the teeth, a study of the development of the dental masticatory apparatus and the measures necessary to produce an organism that will function harmoniously and in accord with the requirements of the human being as a whole.

A COURSE BRIEFLY OUTLINED

We all know that the average student has not been in school long before he has formed the opinion that orthodontia is a sort of "frill" in the course and that it is supposed to be practiced as a specialty. Therefore, he proceeds to do just enough work in the subject to meet promotion requirements. This mental barrier must be eliminated, and I suggest the predental years as the best time to establish the correct premise and then carry it on throughout the rest of the years.

"Orthodontia" should be the course heading in these years, as throughout the regular dental years, with comparative anatomy, oral anatomy and zoology as ancillary subjects. If the scope of the predental work permits, physics and elementary metallurgy should be included. This would be the first step to emphasize orthodontia as a major subject.

In the freshman dental year, again under "orthodontia," we would have a full lecture course built upon and around the subject of occlusion. There is no other department to which more rightfully belongs the study of the evolution of the teeth and their supporting structures from their beginning to the full accomplishment of occlusion. The whole cycle in the consummation of occlusion is a problem of growth and development coupled with the unseen, unappreciated forces in nature, and as occlusion is the foundation upon which dental operations are built, the orientation of the subject should be full, and early established. At this time, there would be included comparative dental anatomy, dental embryology, dental histology and morphology of the teeth, as they have a direct relationship to the development of occlusion. In qualifying these terms as "dental," the word is used to bring out the specific application and not in the sense that "dental" embryology, etc., is in any way different than "general" embryology.

The laboratory technic aspect will be touched on in a later paragraph; but, in this connection, let me stress the thought that modern orthodontia comprises much more than mechanics alone: it is a study of life, growth and development coupled with mechanical principles. It has a biomechanical precept and should be taught as such.

In the second (sophomore) dental year (is it not opportune for us to get away from the "predental years" and speak of dentistry as a five or six year course?), the lecture course would include fundamentals. Starting with a general statement of the objects, aims and purposes of orthodontia, we would carry the student through a historical review, the etiologic factors, diagnosis and classification. References or lectures relating to treatment should be fundamental or basic only in character. Here, applied

physics or mechanics may be included to good advantage and the problems elaborated which refer to force, dynamics, anchorage and resistance as related to tooth movement and the adjacent tissues. Applied metallurgy, including the physical working properties of the metals and the consideration of the various alloys for use, the best metals for the several units of the appliance, etc., should be presented.

In the latter part of this year or the beginning of the next, there should be a short intensive laboratory course in the making of the "expansion arch" or, better, alinement wire. The adjustment of it and its principles should be elaborated through the medium of demonstrations on enlarged (five or ten diameter) models, with all parts enlarged in proportion. The fact should be impressed on the student that these teeth and parts of appliances are in each instance five or ten times the size of the natural teeth and the various parts of the appliance. The application of principles can be shown to a much better advantage on such an enlarged scale.

In the junior year, the lectures should have a direct bearing on the treatment for the various classes of malocclusion. One definite method of treatment should be determined on and that taught religiously: I am convinced that the principles embodied within the "expansion arch" or alinement wire are the safest and best teaching to give the beginner in orthodontia. The student is now introduced in the clinic and assigned, with a senior, to the latter's case or cases. He acts as assistant or technician; he makes the casts, the appliance design and appliances and otherwise assists, this mechanical work being done under the direct supervision of a technician or an instructor who is definitely assigned to this work and who is responsible to the head of the department just as the clinical instructor is responsible to the head of the department for the progress and management of the case. If there is an abundance of clinical material, the junior may be assigned simple cases for treatment as comprehended in the term "intercepting malocclusion."

At this point, it is opportune to say a few words relating to conducting the clinic. The patient is examined and, if accepted, a full series (ten at least) of roentgenograms are made and the facial photographs. The case is then assigned to an instructor, and he assists the instructor with treatment throughout the rest of the course (the junior's introduction to the case and his connection with it has been previously mentioned). The instructor is not only an operator, but a teacher as well, while on the floor. There should be an instructor to every five or six seniors in the clinic. The students are graded on both theory and practice. As the senior passes out of the school, the junior takes up the case.

The senior lecture course includes method of treatment, advanced appliance design, retention, principles of practice, advanced theories, orthodontic literature and a seminar course in which each student participates in the preparation of themes and discussions presented before the entire class.

In discussing this subject as a problem of our schools, a reference should be made to postgraduate and graduate teaching, but time does not permit of this. Suffice it to say that short courses in theory, practice or technology should be given only to those who are of proven worth in orthodontic practice. The regular graduate course designed for specialization, teaching or research should be at least one year in length, with the student devoting his full time to the work or, pref-

erably, the course extended over two years, the student devoting one-half of each day to study. The clinic should be operated every day except Sunday and legal holidays, and no school is justified in presenting advanced courses unless prepared in every way to meet the present-day demand for this class of instruction.

It is inadvisable to undertake a step by step, lecture by lecture outline at this time, but may I assure those who are especially interested that my interest and enthusiasm in this program of education is almost without limit, and as you are now guests in the city where I am receiving enthusiastic support in my effort to organize a major course in the undergraduate and graduate departments, you are cordially invited to visit the orthodontia department at Northwestern University and every courtesy will be shown. Our course is very much in the reorganization stage, but that which we have is yours for the asking.

CONCLUSION

May I remind you that I have long been an advocate of a liberal policy in the teaching and practice of this branch of dentistry? I have had long and close contacts with dental education, specialization and specialists; and no one has a greater desire to see orthodontia properly placed than I, nor is any one more willing to be shown the way; but it will require better arguments than have heretofore been presented to convince me that orthodontia is not a fundamental dental subject, that it is not entitled to every bit as much consideration in teaching as any other clinical branch or that it should be divorced from dentistry or be allowed to sink into a debased commercialized "laboratoryized" branch of dentistry.

There is an urgent need for much closer cooperation by all who are interested in this subject, and it will only be through cooperation and expansion that the full, rightful, justifiable position of orthodontia in the general field of dentistry will be realized.

DISCUSSION

Guy S. Millberry, San Francisco, Calif.: Dr. Hoffman stated that his purpose was to discuss fundamental principles of orthodontic education. Once these are established on a stable foundation, we should be able to erect a substantial superstructure that will provide a competent service for children who need orthodontic service. Included in this superstructure, there must be two elements, the curriculum and licensure, each of which is dependent on the other, and success in practice for both patient and practitioner is dependent on both. Contrasted with cultural education, which is intended to enrich one's life, the aim of professional education is to prepare the individual for service to humanity. Not the least part of this preparation is an appreciation of the responsibility of the orthodontist to his clientele; for if there is any group that is especially deserving of conscientious dental service, orthodontic or other forms, that group is the young children. With the development in other fields of dental technology, the teaching of orthodontics in most dental schools has shown a counter motion. In some instances, this has reached a point in the curricular program where its place in a regular dental course is almost unwarranted. Schools which offer from thirty-six to 288 hours of orthodontic instruction are hardly justified in assuming that their graduates are qualified to practice orthodontics after passing the licensing examinations. The advances made in orthodontic practice in the last decade justify this statement, and the very recent tendencies to offset this by offering graduate study to overcome these defects is a further confirmation.

These educational experiments are but the beginning of a more liberal conception of orthodontic education, which will resolve itself into an expansion of certain parts of our present dental curriculums, chiefly in biologic science, and the deletion of certain other parts which are not essential to the practice of orthodontics, namely, replace-

ment procedures. The second element, licensure, is even more important because it is designed primarily to protect the public and secondarily the orthodontist. Substantive law, by which rights are created, is designed to protect the people. The dental laws are substantive laws; yet we cannot defend them by maintaining that forty hours of instruction in orthodontics in a curriculum ranging from 6,000 to 8,000 hours, during a five year period, is enough to prepare a student adequately for practice in this field. While this is the most important reason for the legal defense of educational standards, there is another, and that is the necessity for protecting the rights of the individual who has, through conscientious effort, prepared himself to render the best type of professional service in any field and in any community. The purpose of legislative bodies and the courts is to make law and legal machinery of practical value to the individual, whether he be the child sadly in need of a service that will make life happier and healthier, or the person well trained to render that service. We must take cognizance of the fact that the world is child-conscious; that child welfare is our most discussed problem; that children of today are interested in each other and recognize each other's defects; that the stigma of noticeable defects often represses the individual throughout life; that their parents and grandparents, the service clubs and women's clubs, the churches, schools and charities are interested in them, and that we must meet our problems in child life. The day is not far distant when the children will go directly to the children's dentist and the orthodontist and by them be directed to the family dentist. For the sake of the children and in defense of their welfare, our curriculums and the legal defense of curricular standards must be considered as a part of any orthodontic program.

AN ACCURATE NEW TECHNIC FOR FILLING ROOT CANALS TO THE DENTINOCEMENTAL JUNCTION WITH IMPERMEABLE MATERIALS

By CARL J. GROVE, D.D.S., Ph.G., F.A.C.D., LL.B., St. Paul, Minn.

PERIAPICAL infection following root canal operations is usually caused by the escape of bacteria existing in the dentinal tubules, by way of the open foramen. Infection of the tubules is a result of pulp decomposition, and the difficulty of completely sterilizing this structure by any method of treatment would indicate that bacteria are ever present in the dentin. The logical assumption is, then, that bacteria are present in the dentin at the time the root is filled. In the acceptance of this premise, it becomes obvious that sealing of the foramen is essential where successful root canal operations are desired; and if it is believed that dentin can be sterilized, the foramen should nevertheless be filled in order to prevent the diffusion of fluids into the canal from the adjacent tissue, for such a condition will be most favorable to infection. It is also apparent that impermeable filling materials must be employed in order to seal the foramen; otherwise, bacteria will migrate through the permeable root filling into the periapical tissue, causing infection.

Many of the materials now used for filling root canals do not possess these physical characteristics, and the frequent occurrence of infection after root canal operations can be accounted for upon this basis.

Another essential is the filling of the canals beyond the point where the dentin ends, in order to make the escape of bacteria impossible. With a filling of this character extending to the dentinocemental junction, bacteria cannot escape from the dentin, and since the cementum is also an impermeable covering of the dentin, the bacteria present cannot reach the periapical tissue. For the successful application of these materials, a definite technic is essential.

Ever since it was first established that cementum formed to fill the apical opening when pericemental membrane remained in the foramen of pulpless teeth, attempts have been made to seal the dentin at this point, but no method has been devised whereby this operation has been satisfactory in the hands of the majority of dentists. The successful results have been accomplished by those especially trained in this work, and the necessity for a technic equal in accuracy and precision to other dental operations is urgent at the present time. This technic must not entail a complicated procedure whereby the dentist will be forced to abandon his present acquired skill in root canal operations, but should be a simple procedure, which will afford definite results with the proper application of instruments suitable to the dentist's present experience in this branch of the work.

Fig. 1.—Measurement control broach holder for posterior teeth.

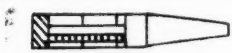

Fig. 2.—Measurement control broach holder for anterior teeth.

For the past few years, I have been experimenting with various types of root canal instruments and materials, with the view of developing such a technic. My object has been to standardize the form and size of the materials to be used in filling root canals on the basis of the instruments employed in opening and finishing the canals, and to devise some means of measuring accurately the length of root canals, so that they could be filled completely, and sealed, preferably at the dentinocemental junction, thereby obtaining an accurate root canal technic, instead of the inadequate method now in vogue. The instrument that I have selected to utilize for measurements and standardized features is the new measuring root canal instrument holder (Fig. 1). This instrument is similar to the ordinary reamer holder, except that a vernier scale has been placed on the side of the handle, with an opening in the center of the handle which makes it possible to observe the exact reading of the length of the root canal, this being where the end of the broach stops. The holder also has a tapering end, allowing it to enter the cavity. A rest is furnished by a shoulder established in the root canal.

Fig. 3.—Cross-section of tooth showing shoulder established in pulp chamber on which broach holder rests.

From the results of these experiments, I have decided on certain materials and instruments because of their particular qualities and adaptability, and I will explain the characteristics and qualities in this article.

Before going into a detailed discussion of my technic, I wish to outline the procedure.

1. Establishing the shoulder. Open into the pulp chamber and establish the shoulder in the upper part of the root canal, upon which the measuring instrument holder will rest. Use the end cutting bur for making the shoulder. (Fig. 2.)

2. Measuring the length of the canal. Take a roentgenogram of the tooth with the instrument holder resting upon the shoulder and a smooth measuring broach in the holder extending the full length of the canal. The approximate length of all root canals may be had by consulting the chart in Figure 3. If the apex has been reached, note the reading on the vernier scale of the instrument holder, where the exact measurement of length of the root canal is obtained. All other root canal instruments are placed at the same reading for use in that tooth, and they cannot go beyond that point because all the instruments are the same length and the previously established shoulder prevents the holder from going beyond the shoulder. This makes the measuring holder an indispensable instrument for measuring, opening, enlarging and finishing root canals. The value of the measurement is to prevent the root canal instruments from passing through the foramen and injuring these tissues, as well as to make it possible to fill the canal to the dentinocemental junction, because the same procedure is used in placing the metal cones in the canal, making it impossible for the filling material to go through the foramen. The holder is stopped by the shoulder.

3. Reaming and filing the canal. After correct reamers have been selected from the chart, files should always be used in order to secure a smooth surface of the canal, making possible a perfect fitting gold cone filling.

4. Placing "neurolite" in the canal. "Neurolite" is an impervious liquid sealer which hardens at body temperature and is placed in the pulp chamber with a small pipet.

5. Placing a gold, silver or guttapercha cone in the root canal. A cone the exact diameter of the last reamer and file used is placed in the holder at the same point on the vernier scale as the reamer, then inserted into the root canal, pumping the neurolite sealer into the canal as it is carried to place. This gives a perfect root canal filling, with absolutely impermeable materials, and affords a most favorable condition for the deposition of cementum in the foramen, since these materials are well tolerated by periapical tissue.

By the use of the measuring root canal instrument holder and a shoulder established in the root canal, it is possible to prepare the canal, and to place the filling materials to any desired point, which by unanimous conviction of all root canal investigators is the dentinocemental junction. While it is impossible to determine this point by any known means, it gives us an objective to work toward at least. In other words, we should fill to the apex, but the ideal point is the dentinocemental junction, and I believe that that is what we should strive for.

THE APICAL DENTINOCEMENTAL JUNCTION

That a definite junction of these two structures exists cannot be questioned, since the dentin is formed proceeding the development of the cementum. This line of demarcation is due to the difference in the histologic character of these tissues. If sections are not cut longitudinally with the apical portion of the canal, a correct representation of this condition may not be disclosed. A convexity or concavity of the surface of the root may also be misleading. This may

occur in the study of sections that are selected at random, but when sections are prepared for the study of this condition, it will be found that a definite junction exists.

The condition that I refer to is not such as is seen when the cementum has been deposited in the foramen of teeth in middle life or advanced age. This is very irregular and no definite junction can be seen. It will also be observed that a large number of canals extend through this structure into the periapical region, and there is also an intermingling of dentin. One should not confuse these with the apical dentinocemental junction.

REFERENCE CHART

Upper Teeth			Lower Teeth		
Tooth	Length of Root Mm.	Reamer* Required	Tooth	Length of Root Mm.	Reamer Required
Central.....	12.25	No. 28	Central.....	11.75	No. 25
Lateral.....	12.75	No. 27	Lateral.....	12.50	No. 25
Cuspid	17	No. 27	Cuspid.....	15	No. 25
First Bicuspid...	12	No. 26	First Bicuspid...	7.50	No. 26
Second Bicuspid.	13.75	No. 27	Second Bicuspid.	14	No. 26
First Molar.....	12.75	No. 25	First Molar.....	13	Mesial R. No. 26 Distal R. No. 25

CHARACTER OF FILLING MATERIALS

The materials must be of such a character that it can be placed in the canal without distortion if the measurement features are to be utilized, and for that reason I prefer metal as the material used. Metal cones are superior to gutta-percha in that they have sufficient rigidity to prevent distortion in placing, and they can be sterilized by heat or by chemical means. They are radiopaque and can be standardized to the size of the reamers used, and the entire metal cone can be removed in one piece, if so desired, any time after the filling has been set.

After using various metals and their alloys, I have decided on gold and silver because they are noble metals and they possess the proper rigidity and elasticity, which is essential, and are not acted on by the constituents of the secretion. It has been demonstrated by its vast use in reconstructive work that it will be easily tolerated by the tissues, and it will not discolor the tooth. It also possesses many other desirable qualities.

Neurolite is absolutely impermeable, and is very cohesive. It will seal the walls of the dentin so that it will be impossible for bacteria or their toxins to enter the periapical tissues. It is especially well tolerated by the periapical tissues and causes no irritation whatever. It will set in moisture at body temperature, and is slow setting, giving ample time for the most difficult operation. It is impervious, and is not acted on by the secreted fluids. After the metal cone and neurolite have been placed in the

canal, the latter sets at body temperature, becoming very hard and tough. If, at any time after that, it becomes necessary for any reason, the filling can be removed by applying the heat of an instrument to the cone, which softens the neurolite sufficiently to allow easy removal in one piece; whereas, the removal of guttapercha is always an arduous task, and sometimes impossible. The neurolite remaining in the cavity can be easily removed with a reamer.

The measuring instrument holder, as was shown in Figure 1, has a tapering end, which allows insertion into the cavity and pulp chamber. The end forms a rest, to place on the shoulder in the root canal from which the measurement starts. The point on the vernier scale at which the end of the stem of the broach stops gives the exact length of the root canal in millimeters.

The tapering reamers Nos. 25-26-27-28 should be used with this holder because they are the proper diameter and are cut the proper length to give the measurement of the root canal. These instruments are made according to a recent measurement that I have made of the diameter of several thousand root canals at the apex, and at a point 7 mm. above the apex, with no attempt to enlarge the canal above that point.

Before we can intelligently discuss different conditions in pulpless teeth, we must come to some agreement as to what conditions exist in different phases of root canal disease, and as to how to handle the different conditions. For this reason, I have worked out a classification of pulpless teeth, which I believe will make the discussion of this presentation more clearly understood.

CLASSIFICATION OF PULPLESS TEETH

Class 1. Teeth having exposed noninfected pulps.

Class 2. Teeth having infected pulps.

Class 3. Teeth showing acute periapical infection.

Class 4. Teeth with partly filled canals and noninfected periapical tissue.

Class 5. Teeth showing chronic periapical infection or rarefied areas.

TREATMENT

In Class 1 cases, the entire operation may be completed at one sitting. If it is more convenient to divide the work into two sittings, a dressing of a 10 per cent solution of glycerocresol should be sealed in the canal.

When sealed in the root canal, it affords a mild antiseptic action and keeps the canal in a sterile condition, for it is miscible with water in all proportions and will not coagulate albumin.

In Class 2 cases, the pulp chamber is opened and chlorothymol is sealed in the canal and left in for three or four days. At the second sitting, the rubber dam is adjusted. If the dressing is free from odor and a culture is negative, we proceed as in Class 1. If an odor is noted, we seal in another dressing of chlorothymol and leave it for three or four days before completing the operation.

Chlorothymol is a preparation of chloral hydrate and thymol, each mixed in a warm mortar until liquefied, and acetone, 20 minims.

In Class 3 cases, we treat with chlorothymol until the odor disappears, then take a culture, and if it is negative, treat the case as of Class 1.

In Class 4 cases, we place a rubber dam on the tooth and proceed to remove the root filling, take a culture, and if it is negative, proceed as in Class 1 (if positive, we treat as Class 2).

Class 5 cases are hopeless and in my opinion these teeth should be extracted.

DETAILED TECHNIC OF SURGICAL PULP REMOVAL AND FILLING OF THE ROOT CANAL

In all cases of devitalization, it must be remembered that asepsis plays an important part in the success of any surgical operation, and absolute asepsis must be adhered to in every step of the procedure.

Step 1. Take a diagnostic roentgenogram to determine in which class the tooth belongs, and what form of treatment is necessary.

Step 2. Adjust the rubber dam, swab the tooth with alcohol, iodin or mercurochrome and open into the pulp chamber with sterile instruments.

Step 3. Establish the shoulder deep in the pulp chamber with a sterile end cutting bur.

Step 4. Refer to the accompanying table to determine the approximate length of the root in question. Place a smooth measuring broach in the measuring root canal instrument holder so that the end of the broach is on the figure required on the vernier scale. Extend the broach into the root canal until the instrument holder rests on the shoulder in the pulp chamber. Then take a roentgenogram with an instrument in the canal, and if the broach is beyond the apex, remove and shorten and repeat the picture. If too long, extend and repeat. When the picture shows the smooth broach at the apex, remove the holder and note the reading on the vernier scale, as this reading is the exact length of the canal and all other instruments will be placed in the canal the same depth.

Step 5. Place a fine barbed broach in the holder to the reading established by measuring the broach, and insert into the canal the full length and remove the pulp tissue. This insures complete removal of the pulp to the dentinocemental junction.

Step 6. Consult the table for the size reamer to be used in the tooth in question and place in the instrument holder at same point as the measuring broach and ream the canal until the instrument holder is resting on the shoulder in the pulp chamber; which indicates the end of the root canal has been reached.

TECHNIC FOR OPENING CONSTRICTED CANALS

If difficulty is encountered in opening into the root canal, it may be overcome by using hydrochloric acid and hexylresorcinol, a preparation composed of hydrochloric acid and hexylresorcinol. The hydrochloric acid decalcifies the dentin and forms a soluble substance which will not clog the canal as in the case of the residue formed by the action of sulphuric acid. The soluble substance permits the hexylresorcinol to come in direct contact with the bacteria present. Hexylresorcinol is a very efficient germicide which is carried into the matrix of the dentin by the action of the hydrochloric acid, this affording an exceptionally deep penetration of the antiseptic.

Step 7. After the reaming has been accomplished, finish the canal so that the walls will be smooth, affording a clean surface upon which to place the metal cone.

Step 8. Place a very small quantity of neurolite in the root canal with a pipet. The metal cone the exact size of the last reamer and file used is selected as indicated in the table and affixed in the instrument holder at the correct length, determined by the vernier scale on the holder.

Step 9. Place the cone in the root canal and pump the neurolite to place as it is carried to the apex. Only a small

quantity of neurolite liquid is necessary because the metal cone fits perfectly for 7 mm. from the apex; the main purpose of the neurolite being to seal or to set the cone rather than to serve as a filling material, since the cone serves this purpose.

Step 10. Fill the pulp chamber with cement and proceed with the proper restoration.

The point I wish to leave with my readers is that to insure uniform results in root surgery, we must use the same care and skill that are employed in other important branches of dentistry.

Much of the argument set forth in the support of the theory that all pulpless teeth are infectious is wholly lacking in proof. The technic used in obtaining cultures by severing the root end and placing it in culture mediums is faulty because it does not prove that the growth is obtained from the outer surface of the root as the reports of these findings imply, but, on severing the root, dentin is exposed, and the growth may be the result of a contamination from the inside of the root and not from the cementum, which would not be infectious if the foramen is hermetically sealed. Since the cementum is an impervious structure, the foramen would be the only exit of escape for the bacteria present in the dentin. It is not at all improbable that the dentin may harbor bacteria for a long period after the root canal is filled. Laboratory experiments have proved that faulty restorations do permit a diffusion of fluids in the dentin which could supply nutrition to the bacteria from the mouth.

A tooth with the foramen sealed would be comparable to a glass tube with an opening at one end, the cementum corresponding to the glass of the tube. No bacteria could escape through the sealed end and no ill-effect could result if the end came in contact with vital tissue from the bacteria inside the tube, but if the end was severed and placed in suitable culture mediums, a growth would naturally follow. The same results would occur when the root end is severed and placed in culture mediums, if bacteria were present in the dentin.

It can readily be seen that findings of this character are very misleading and have caused the needless extraction of many teeth.

CONCLUSIONS

1. An accurate simple root canal technic may be applied by the general practitioner with the same precision as other important dental operations.

2. The means of measuring root canals opens new possibilities in root canal work.

3. By standardization of the size of root canal filling materials to the size of root canal instruments, a perfect fitting filling can be produced.

4. The use of impermeable nonirritating materials in filling root canals prevents the migration of bacteria from the dentinal tubules to the periapical tissues, and furnishes ideal condition for the deposition of secondary cementum in the foramen.

5. The classification of pulpless teeth makes it possible to discuss root canal disease so that it is readily understood.

SOME FACTORS IN SAFE AND EFFECTIVE NITROUS OXID-OXYGEN ANESTHESIA IN ORAL SURGERY

By J. A. HEIDBRINK, D.D.S., Minneapolis, Minn.

GIVEN any good technic, which of necessity provides sufficient oxygen during induction and maintenance of anesthesia, the careful and methodical procedure in the administration of nitrous oxid-oxygen insures the highest degree of success in anesthesia obtainable. I have found little to change in my procedure for a number of years; therefore, there is little that is new to present here. It is the object of this paper to stress the necessity for attention to a number of the small details which, if overlooked, may hinder or even prevent anesthesia.

The first requirement is suitable apparatus sufficiently flexible and accurate in performance to deliver the gases continuously in known proportions and volume as needed, and to deliver large volumes of pure oxygen to the patient, with the breathing bag closed or open.

The nasal inhaler must be snugly applied and of a type to exclude air and permit the patient to breathe the gases freely. The mouth, having been propped open, is covered during induction preferably with a mouth cover inhaler which not only seals the mouth and excludes air, but also permits inhalation of the gases through the mouth. This is always comforting to the patient, and is especially advantageous should there be any nasal obstruction or a natural tendency or temporary persistence on the part of the patient to breathe through the mouth. Patients free from nasal obstruction who persist in mouth breathing during induction will usually revert to nasal breathing as soon as they are anesthetized.

It is well to see that the inhalers are snugly applied by observing the bag. With the exhaling valve only slightly open (I open it one quarter turn), the bag, after a few seconds, will fill to distention on each exhalation before the exhaling valve opens to permit the escape of exhaled gases. Thereafter, the exhaling valve will open with each exhalation, provided the inhalers are snug.

The manner of propping open the mouth is important, for should the prop be dislodged, the procedure is held up until the mouth can be pried open and the prop reinserted. With rigid muscles, this is sometimes difficult and hazardous to any frail bridged or filled teeth. Often, sufficient air is inhaled to lighten the anesthesia or cause the patient to awaken. Such an occurrence is annoying to both the patient and the anesthetist.

Recently, a young perfectly normal female patient of slight build, started to struggle in the middle of the induction and continued struggling so hard that I became curious and decided to discontinue the anesthetic, whereupon I discovered that the prop had become dislodged. On recovery, the patient stated

*Read before the American Society of Oral Surgeons and Exodontists, Minneapolis, Minn., Aug. 18, 1928.

that her struggles were directed toward informing me about the dislodged prop. She stated that she never had resisted the anesthetic before. The prop was more securely placed and she took the anesthetic quietly.

A dentist of my acquaintance was recently confronted with a damage suit because the prop became dislodged in the mouth of a child and shifted to the front position between the incisor teeth in a manner to force out of the sockets two lower incisor teeth. In children, there is likely to be unusual rigidity of the muscles during anesthesia.

There should be at hand a supply of rigid props with rubber covered ends, in four or five lengths, and at least two of each length. These props must be of a form to take up very little space laterally so that they will not be in the operator's way. Two of each length (or size) should be tied together with a string 8 or 10 inches long. This facilitates recovery of any prop that may fall into the throat, and if work is to be done on the other side of the mouth, the correct prop is immediately available and should be placed just before the first prop is removed. In order to select the proper length of prop, the patient should be asked to open the mouth wide and a prop should be chosen of such length that it will hold the mandible in that position and that it may be placed back far enough to be out of the operator's way.

For the safety of the patient and for easier anesthesia maintenance, the posterior part of the mouth should be well packed before operation is begun. Suitable packs can be made by forming a square of cotton and sewing through the center with string, leaving 6 or 8 inches of string attached. The square of cotton which is thus sewed should be of a size that, when rolled into the form of a cylinder, it will be about 2½ inches long and 1½ inches in diameter. Before inserting the cylinder, it should be trimmed to the size which, in that particular mouth, will close off the throat but will not force the tongue back or unduly fill the oral cavity.

To pack the throat, place the cylinder on the tongue and with the first and second fingers of the right hand in contact with the roof of the mouth, roll the cylinder over and back until the throat is closed off. This rolling motion carries the tongue forward. Care should be exercised not to force the pack far enough to push the soft palate back in such a way as to interfere with breathing.

In some cases of nitrous oxid anesthesia, enough reflexes remain active in the soft palate to keep it from tolerating the contact of the pack without retching movements. In such cases, the pack is pulled slightly forward, out of contact with the palate, by the string sewed through the pack, which hangs from the corner of the mouth.

As there is not always opportunity to tell patients to forego the previous meal dental patients are often anesthetized with more or less food in the stomach, which predisposes them to nausea and vomiting. When vomiting threatens, the pack should be brought forward or tucked to one side to provide egress for the vomitus should it come suddenly. When vomiting occurs, the pack should be removed and the anesthetic temporarily discontinued. The mouth prop should be left in to prevent possible closure of the mouth from muscle tension. It is never permissible to attempt to hold back vomitus, even for a moment, in order to complete an operation however little the time required; for it might thereby be forced into the trachea.

In cases in which there is much secretion or bleeding during the operation, it is better to swab out the front of the mouth than to remove the blood-soaked pack for the purpose of changing it, because, when it is removed, blood and mucus will go back, and if they get into the trachea, will cause coughing. If they get into the stomach, they may cause nausea. When the operation is completed and the pack can be removed, fresh cotton should be placed where the teeth were extracted.

Disregard of the factors enumerated above may prevent uniformly good results even with the best technic. With proper attention to these factors, any one who will routinely carry out in every detail any good anesthesia technic, can demonstrate that average normal patients react in a surprisingly uniform manner.

For instance, if 7 per cent of oxygen is administered with the nitrous oxid (in volume to supply breathing) for the first minute of induction, a large proportion of patients will pass into a quiet and comfortable anesthesia of a depth to cause the eyeball to be fixed off center in about one minute and forty seconds from the beginning of induction. The symptoms of anesthesia will be sufficiently delayed to permit easy interpretation; there will be little or no excitement stage, and, in many cases, the plane of anesthesia reached at the end of the minute and forty seconds can be maintained for mouth surgery by the administration of 93 per cent nitrous oxid and 7 per cent oxygen after the minute and forty seconds.

The introduction of this one element of timing a uniform technic of gas administration places at the disposal of the anesthetist a more accurate means of classifying patients than would otherwise be possible. If there is no uniformity in technic, the anesthetist has no means of determining whether the difficulty in any given case lays in the technic or in the patient. Since the administration of 7 per cent oxygen with the nitrous oxid, for the first minute, is a most favorable technic for all types of patients, the anesthetist will know that any difficulties which develop during that time lie in the patient and not in the technic. The uniform technic will enable the anesthetist to diagnose the kind and degree of difficulty which may develop at any stage of the anesthesia and will suggest the remedy.

The anesthetist naturally forms the habit of classifying patients by appearance. This often yields information of great value and is a habit to be carefully developed. However, even with the most highly developed ability on the part of the anesthetist, the visual classification of patients is very unreliable and may be seriously mistaken in many cases, as in the case of the patient with a red nose and the facial appearance of an alcoholic, who has never taken a drink. On the other hand, many confirmed alcoholics show no visible indications. The reaction of patients to a uniform technic will afford much additional information as to the kind and degree of any difficulty, and this information will be much more exact than that obtained by visual classification.

The uniformity of susceptibility of patients works to the disadvantage of the patient and operator if the methods, apparatus or technic is faulty, because results are likely to be uniformly unsatisfactory. For instance, if pure nitrous oxid is administered, the stages of anesthesia may overlap more rapidly than can be recognized and controlled by the average anesthetist; or the dental centers may not have been anesthetized

when the other centers which produce the usual symptoms of anesthesia have been anesthetized; or the anesthesia may gain such momentum from the rapid administration of the gas that the patient will pass into deep and undesirable stages. If efforts are made to bring such patients back to a proper degree of anesthesia by the use of air or oxygen, it frequently happens that the patients are brought back too far and induction must be resumed. If patients are alternated between too deep and too light anesthesia, the anesthetist is likely to lose confidence in himself or in the anesthetic, the operation may be delayed and nausea and depression, which might otherwise be avoided, are very likely to result.

If the methods, apparatus and technic are complete and uniform, this uniform susceptibility in normal adult patients makes possible uniform quiet and efficient anesthesia with a maximum of safety, in a short time, in a manner comfortable to the anesthetist and the patients and unlikely to cause nausea or depression.

Many of the patients who, with a good technic, pass into a quiet and comfortable anesthesia, with no serious trouble, possess possibilities which, under the influence of a bad technic, might develop into difficulties sufficiently serious to make anesthesia difficult or impossible.

Those who fail to strap effectively or otherwise restrain powerful athletic or excitable patients or suspected alcoholics are almost sure to encounter experiences with struggling which they would not care to have repeated and which might discourage the further use of nitrous oxid. Effective strapping of the patient is easily accomplished without his knowledge, inconvenience or objection.

In most cases, when there is undue struggling or resistance to the anesthetic, the difficulty is physiologic and lies within the patient. It may be of sufficient extent to interfere seriously with inducing a satisfactory or safe anesthesia regardless of the technic used. Such conditions can be largely corrected or entirely eliminated by properly preparing the patient by premedication. There are several premedicants from which to choose. Morphin, one-quarter grain for men and one-sixth grain for women, has been found quite satisfactory. It is only an occasional patient that requires such premedication for ordinary dental anesthesia. Chloretone, from 10 to 20 grains, or two to three tablets of a barbital preparation may be given by mouth with beneficial effect.

I prefer to operate in what I term the second plane of surgical stage anesthesia, the symptoms of which are: eyeballs fixed off center, lid reflexes abolished and breathing rhythmic, with no jactitation evident. Others may desire a somewhat lighter anesthesia, such as the first surgical plane (in which the eyeballs are oscillating), or they may choose to further slow up the induction by using more oxygen or by continuing it throughout the induction. These are matters that the anesthetist may determine for himself. Anemic and debilitated patients and most children I prefer to anesthetize by using oxygen throughout the induction.

If, during the induction, oxygen is discontinued after the first minute, eyeball oscillations in adults may be looked for and expected in about thirty seconds, at which time oxygen may be reinstated, and we can then wait for the eyeballs to move off center. This prevents the anesthesia becoming undesirably deep should the anesthetist hesitate or be slow in recognizing the second plane surgical stage symptoms. Any enlargement of pu-

pil (usually accompanied by anoxemia symptoms) is indicative of deep and dangerous stages. The iris is the last visible muscle to come under anesthetic control. Any undue cyanosis or other indications of anoxemia or overdose of the anesthetic should be promptly corrected with oxygen.

In order that the anesthesia may be lightened without causing awakening, it is desirable to supply the oxygen to the patient with the breathing bag shut off and the nitrous oxid flow stopped. The patient is allowed a breath or two, or more if needed. This delivers the oxygen most quickly and definitely and leaves the contents of the bag unchanged for resumption of administration of the anesthetic.

Should the air passages become restricted or blocked by the tongue, it should be grasped at its root with the index finger and carried forward. Should the breathing be slowed or stopped, pressure is made on the chest with the hand at breathing intervals until the patient resumes breathing, which he usually does promptly.

In recent years, carbon dioxid is receiving recognition as a valuable aid in the administration of anesthetics. John S. Lundy, of the Mayo Clinic, in 1925 reported its use in connection with gas anesthesia in 1,350 cases of major surgery and also for dental patients.[1] At this time, I attempted to use carbon dioxid routinely, but, in the first few cases, I encountered unusual nausea, which I attributed to the carbon dioxid, and I therefore discontinued its use.

Several months ago, I discussed these matters with H. B. Clark of St. Paul, and he informed me that he had been using carbon dioxid in all of his anesthesias for oral operations for over two years with gratifying results. This led me to try it again. After administering it with nitrous oxid-oxygen in practically every case for a number of months, I believe that it is decidedly beneficial and the nausea formerly encountered was coincidental and not due to carbon dioxid. Concerning its relaxing effects, Dr. Lundy says:

> Future investigation may explain how carbon dioxid assists in producing relaxation, if it actually does produce it. In certain cases, when it is used during light anesthesia, the fighting of the excitement stage is lessened or eliminated. Possibly, control of the respiratory center or breathing reflex causes struggling to disappear to some extent. . . . In some anesthesias it seems that carbon dioxid, by producing deep breathing, has coordinated the reflexes to such an extent that the nervous, tense patient becomes as quiet as in normal sleep . . . It might be said that carbon dioxid, when it is functioning as desired, brings an otherwise tense patient to the relaxation of sleep, and that the anesthetic agents carry the patient on into a state of complete relaxation. Carbon dioxid, when used in proper amounts with anesthetic agents, seems to contribute definitely to the relaxation.

I presume that Dr. Lundy would not have us infer that an alcoholic who has not received premedication, for instance, would be thoroughly relaxed by the use of carbon dioxid.

It has been noted that without carbon dioxid in certain cases during induction, more often just prior to entrance into surgical stage anesthesia, respirations may become slow and shallow, with the result that the blood is not being sufficiently aerated and the patient will show oxygen lack before anesthesia is reached. This condition frequently heralds the approach of nausea. If this condition persists, it is desirable to push the administration of oxygen and begin the induction anew. If the patient himself

1. Lundy, J. S.: J. A. M. A., 85:1953-1955 (Dec. 19).

corrects the breathing or if breathing can be sufficiently assisted by intermittent pressure on the chest or otherwise, deeper anesthesia stages may be reached where the anesthetic makes breathing rhythmic and controls retching and vomiting. Carbon dioxid deepens the respirations and compels the patient to breathe. When there is nausea and retching, the breathing slows or temporarily ceases. No patient can breathe and vomit at the same time. Neither can he breathe normally and retch. With carbon dioxid used in correct amount from the beginning of induction, the patient is compelled to breathe satisfactorily and consequently does not retch or vomit, and passes on into anesthesia stages where the anesthetic controls vomiting. In this manner, many anesthesia interruptions are prevented by the use of carbon dioxid.

With carbon dioxid used as needed to maintain desirably deep respirations during anesthesia maintenance, the blood will be better aerated and there will be much less cyanosis, and surgical stage anesthesia symptoms will be more mild. With this anesthetic condition, undesirably deep stages are much further removed and the margin of safety is materially increased.

In an article entitled "Anesthesia by Nitrous Oxid, Ethylene, Carbon Dioxide and Oxygen for Dental Operations on Children,"[2] Dr. Lundy describes how carbon dioxid contributes to the safety and effectiveness of gas anesthesia in children and speaks of its value for purposes of resuscitation. He points out that because the character of the respiration of a child under nitrous oxid oxygen is especially uncertain, carbon dioxid is most useful in anesthetizing children.

2. Lundy, J. S.: Dent. Cosmos, 67:906 (Sept.) 1925.

I find that by using from 3 to 5 gallons of carbon dioxid per hour, I can more easily anesthetize children and maintain anesthesia with little or no cyanosis and with apparently less muscle tension.

Carbon dioxid may be started early in the induction at 5 gallons per hour, and usually there will be no indication for changing it throughout the administration. The amount may be increased at any time if needed, to maintain deep respiration. If, at any time, there are overvigorous movements of the chest and abdomen, the carbon dioxid should be reduced or discontinued. Decided overdosage would cause coughing and breath holding.

The equipment and the technic for administering carbon dioxid are quite simple and inexpensive. A carbon dioxid attachment is provided to deliver and indicate any desired volume, and its delivery is limited to usable permissible amounts.

Carbon dioxid is best supplied from a tank because it can be instantly obtained in more exact amounts than by rebreathing. Rebreathing does not supply carbon dioxid fast enough to be effective during induction; also, a full volume of the anesthetic gases are needed to satisfactorily maintain anesthesia with the patient's mouth open. Therefore, it is impracticable to employ rebreathing to any considerable extent in dental anesthesia.

DISCUSSION

Harry M. McFarland, Kansas City, Mo.: Dr. Heidbrink suggested the use of chloretone a good many years ago as a means of premedication. Since he made that statement, there have been many who have claimed that it is not a good thing to use as it has a very detrimental effect upon the kidneys, and other disadvantages have been suggested. I should like to ask Dr. Heid-

brink in what percentage of cases premedication is indicated.

E. W. Smith, Kansas City, Mo.: We have to care for patients when they come in, and frequently they have been eating. We have other patients who wish to know how they can prepare themselves for operation, especially they inquire as to whether they should eat breakfast. We have had the same patients repeatedly and we have made this discovery. If they do without their breakfast entirely, especially people who are in the habit of having coffee for breakfast, and then come in about ten o'clock in the morning, they are not really in a normal condition. We have found that if we tell them not to eat a hearty breakfast, but if they are used to coffee they had better drink it as usual, they make better patients than if they do not have their coffee.

Earle H. Thomas, Chicago, Ill.: It has always been my opinion that alcoholics are already premedicated. Is that so?

Dr. Heidbrink (closing): Nausea under nitrous-oxid anesthesia is not so frequently encountered that I deem it necessary to prepare all patients by having them forego the previous meal. If opportunity offers, they are told so to do, or, if they will be more comfortable with some breakfast, they may have one piece of toast and a cup of coffee if they are accustomed to drinking it. Many who come without appointment are anesthetized at once, rather than sent away to be possibly worried about the ordeal that they must face at a future date. To most patients, the removal of teeth is an ordeal. I would rather contend with the infrequent nausea and vomiting than the fear and trembling that may result from postponement. Dr. Harms of Omaha has recommended giving orange juice on the day before and on the morning of anesthetizing. He claims that it has the effect of reducing or preventing acidosis. It is my observation that most people are more comfortable if they partake of something for breakfast. Should there be any retching, we should always be watchful for vomiting, and should remove any throat packing and keep the passage way free for the egress of vomitus. Otherwise, it might be forced into the trachea. Some patients have an unusual tendency to nausea and are likely to become nauseated when an anesthetic is administered. Many of these have indigestion, and food will remain undigested in the stomach for three or four hours. Naturally, it is better to anesthetize such patients with the stomach empty.

FACTORS IN PERIODONTAL TREATMENT*

By AUSTIN F. JAMES, D.D.S., Chicago, Ill.

MY early experience in dentistry was discouraging because of failure following my most earnest endeavors. Many times, the same causative conditions continued in mouths after the completion of reparative work.

The idea of prevention became uppermost in my mind and it has continued to be my effort. I have followed more or less all the fads and fancies in their time. This has finally led to the conviction that I can, at least, put any set of teeth into the cleanest possible condition and teach the average patient how to maintain the result. Having done my part consistently, I find that Mother Nature is always ready to step in and do her full share.

When we study the pathology of tissue cells, there is always evidence of tearing down and building up. There is never any standing still where living organisms exist, and as long as there is life, the building up predominates. To those

*Read before the Chicago Dental Society, May 21, 1929.

who are attempting to prevent or cure disease, this fact is most encouraging.

Pyorrhea can never be thought of as a disease that could be passed on from one individual to another, or, for that matter, from one tooth to another in the same mouth. It is truly a local infection which may be induced by many conditions. There is no doubt that general systemic conditions caused by faulty diet, metabolism or disease will lower the local tissue cell resistance so infection may more readily occur. It is universally conceded that where infection is present, bacteria are growing in sufficient numbers to attack the tissue cells; also, that when we are rid of bacteria, infection disappears. Why there are such things as bacteria is hard to understand. On the other hand, they may have a right to exist. We must make it our business to determine where they may *not* grow, and this must be done just as we fight any other pest, by getting rid of the places that harbor them. Returning to our particular field of operation, the mouth, there is no doubt in our minds that the normally clean set of teeth and healthy mucous membrane are among the greatest evidences of wellbeing that can exist. The lack of these means disaster to both health and appearance.

It has been asserted that pyorrhea infection is due to streptococci attacking the tissue cells, and if the necks of the teeth were kept as clean as the crowns, pyorrhea would be unknown. I believe this is true but we must also eliminate the pockets that harbor bacteria or, if the case is seen in time, prevent their forming, and this involves many procedures.

If there are any grounds for my attempting to discuss this subject, it is because my life effort has been to work out in detail and simplify preventive and corrective treatment.

Diagnosis of a dental case involves little that is different from the procedure of the physician in studying the general appearance and condition of his patient; namely, the diet, habits of hygiene and time given to rest and recreation.

In examining the mouth and teeth, it has been my habit first to observe the occlusion, the length of cusps, the general color of the gums and the cleanliness of tooth surfaces. The depth of pockets and looseness of teeth interest me very little until I have formed some estimate of what has been the probable cause of the destruction of tissue cells, as there can be no pockets unless there has been absorption of the alveolar process. To my mind, lack of function is the greatest etiologic factor among civilized races. All supporting structures as well as the teeth themselves were intended for vigorous use, which they do not have with our modern foods and ways of living. The act of tearing and grinding would wear down the cusps and also give the supporting structures the needed resistance and development. Abnormal occlusion, loss, or breaking down, of one or more teeth or prominent cusps not in normal function have a tendency, in many types of individuals, to bring about what is known as occlusal trauma, which simply means that leverage force has been established. As a result, lowered resistance and destruction of tissue cells occur.

More than twenty years ago, this fact was beginning to be recognized, and I saw Dr. Hutchinson, in his office in New York City, grind down the cusps of pyorrheal teeth to relieve the wedging stress. This radical treatment so shocked my sense of respect for the natural tooth that I could never follow that practice; but a consciousness that there was something happening in these cases that

should be relieved or corrected kept me struggling to find out what could be done.

The Gysi principle of grinding the buccal cusps of the lower and lingual cusps of the upper teeth to balance the occlusion in artificial dentures was the first clue to what has finally evolved a means of relief for trauma in a natural set of teeth.

In cases of malocclusion in which all the teeth are present, orthodontia is the only corrective measure; but, in many instances, very little grinding will give excellent results.

We begin by having the patient bring the mandible to incisal occlusion, noting how many of the anterior teeth actually occlude in that position. Then, with a perfectly mounted three-quarter inch stone, we point or true up the incisal line of the upper incisors and sometimes the cuspids, to as nearly a perfect esthetic appearance as possible. This accomplished, the patient bites on carbon paper to mark the incisal edges of the lower incisors and, with a smaller stone, they are ground until all occlude in a forward and backward sliding movement of the jaw. This will often bring some of the cusps of the molars or biscuspids into interference. The carbon paper is again used with the teeth in incisal position. The posterior interfering cusps are then ground until there is no jarring or bumping of these cusps in the forward and backward movement. Heavy carbon paper is then placed on both sides at the same time; normal occlusal stress is exerted, and the points of heaviest marking are ground until there is no movement of any tooth in its socket; in other words until there is no interference and a balanced occlusion is obtained. This may seem radical, but I can say that there is no mutilation of the teeth. We find that the interference has come from unworn cusps and from teeth that have been driven buccally or lingually until one cusp or another has been raised out of its normal position.

As a further argument in the justification of this procedure, the teeth will soon be lost if it is not done. In a mouth in which teeth have been lost or are badly broken down from cavities, or where proper occlusion has been neglected in making restorations, the bite becomes closed. The study and diagnosis must then be made from the standpoint of the Monson technic, establishing the approximate closure from the normal bite, and determining the occlusal planes and center of force to be restored by building up mechanically with whatever type of work seems best suited to the case.

In my own practice, clearing up infection is the simplest part of the problem. The only question as to whether a tooth can be saved is that of bone destruction. If a tooth has lost all bone support, it should be extracted. If it is loose from inflammation, it can be saved. Infection about the teeth is no different from infection in any other part of the body. If we clear up and get rid of the places harboring bacteria, we eliminate the infection.

In this day of the Cameron and Friedman lamps, one can actually see all forms of calcareous deposits on the teeth, both on and below the gum line. There is no excuse for any dentist's not being able to remove them.

The only other measure necessary is to put the exposed tooth surfaces into such condition that the patient can keep them clean, then teach him *how* to keep them clean.

PRESIDENTIAL ADDRESS TO HOUSE OF DELEGATES, PACIFIC COAST DENTAL CONFERENCE

By JOHN E. GURLEY, D.D.S., F.A.C.D., San Francisco, Calif.

IT is with real pleasure that we welcome you as delegates to the second triennial meeting of the Pacific Coast Conference, and ere the day is spent, the same welcome will be extended to the members of the conference.

Looking back for just a moment over the past few years, it hardly seems possible that seven long years with the length of seven long summers can have passed, since a few of us sat together on the piazza of the Ambassador Hotel in Los Angeles, and started this organization.

Just as history is described as being His story, i. e., the story of divine intent; just as evolution is a process by which changes are made from one thing to another over a period of time, gradually passing, let us say, from simple to complex, from low to high; so organization is said to be that which passes from origination to organization. Man never lived alone; he has always, in some degree at least, required the help and cooperation of his fellow man, although time was when we did think and even work more individually than now.

But as time continued to run its course, certain inevitable changes took place. The numbers of men increased; facilities for communication and transportation increased; and with these came the need for wider contacts, and hence the great increase in the number and extent of organizations. Time was, perhaps, when the only organization was that of the family; men knew but few men and within confined areas; and with these, interchange of ideas was easily possible. Then came organization within these small areas, as numbers increased. But now, when we can go from Juneau, Alaska, to Oakland, Calif., in one day, our acquaintance with men increases, and we must develop the means whereby we can know each other more intimately. So within our own ranks, we have passed through the period of individualism, and small organization, city, county, state, and now reach out for combinations of these, and on through to the national. The man of today, even he who lives in a large city, becomes provincial indeed, if he does not reach out to know men in other large cities. Of how great help, then can we be, one to the other, and community to community! Let us strive toward this end! And as time goes on, let us look for and count the benefits as they accrue to each of us.

We are assembled here as a house of delegates, but with a peculiar function. We have a certain limited power, i. e., as to questions pertaining to this conference group. We can take no action that would in any way bind our parent associations. But, as our name implies, we are in conference, looking for that thing or those things that we may recommend to our various state associations for approval or adoption. There is nothing to interfere with our concurring on

any question and thus making uniform recommendations to all. By this means, we grow, and thus serve one another.

It has been my pleasure and my honor to serve as your president for the past three years. My term of office is soon to be closed. It would be time wasted if some observations had not been made.

In looking over the past and in contemplating the future, there are some observations which I have made and there are some thoughts which have occupied my mind. I ask your indulgence for a brief period that I may present them to you, and if in your judgment they appear worth while, we may enter into some discussion, and prepare ourselves for the advance of the next triennium.

OUR CONDITION

As a conference group, we are now well set, I am sure, for a long and useful career. Of course, the foundation might be easily knocked out at any time; yet the interest from all sections appears to be so unanimous that I have no hesitancy in making this statement.

Much praise and credit are due and must be given the men in Portland for the great start which they gave us. As you well remember, they had a splendid program; they gave us a most wonderful time socially, and, beginning their campaign with borrowed money, they netted above all expense the magnificent sum of $3,250.00, in round figures.

I often wonder whether it is through courage or ignorance that a group of men are able to undertake such a task. But no matter what may have been the prompting motive, they succeeded, and we can testify to the fact that there is no ignorance there. All hail to them, and may we be as successful in the future.

Their profit gave us a fine start — it carried us along until returns began to come in from our own sources, and so our task has been made much easier. As to possible profit for this triennium, we estimated theirs at 15 per cent, and have set that as our goal, as a minimum, though we confidently expect it to be larger. A few days more, and we can make a fairly good estimate.

ORGANIZATION AND FINANCE

Early in 1927, the officers and councilmen of the California State Association were invited to meet with the local officers of the conference to talk over the task ahead. At this time, I asked their endorsement of a certain group of men to act as an organization committee. This committee met later and selected chairmen of such committees as we felt were necessary to arrange for this meeting. These chairmen selected their own members, submitting their selections to the organization committee, that duplications might be eliminated. Thus, our organization of approximately 100 persons was built up.

Each committee has had a certain definite duty to perform, and in its performance, it has been left alone to initiate and prosecute its work. Frequent meetings have been held, at which time reports were made, and thus all our efforts have been correlated.

Each committee is important in that its task accomplished is essential to work well done by the entire group. But I am sure that none will accuse me of unfairness if I take this opportunity of paying my respects to the finance committee.

Our chief object, of course, is to provide a program and entertainment. But these cannot be had without the wherewithall. This is provided by the sale of exhibit space and memberships. Some one is entitled to credit for this labor, and unstintingly we give it. But a wise expenditure is even more essential. In this,

E. G. Sloman, chairman of the finance committee, has rendered this conference a most valuable service. With those who had to do with the raising of money, he has conferred and carefully estimated the possible amounts to be received. Then, in turn, with those who have had to do with its expenditure, he has carefully made their appropriations, thus providing a budget, to which he has held. Only once have we had to reevaluate the income and expense, all other increases of any committee being cared for by a corresponding reduction of another. In this way, we have been able to guide ourselves definitely and know at least whether we were following a pretty straight line in our endeavors. Not a cent has been paid out without its going through his hands, and he has always provided a voucher signed by the president and treasurer, authorizing its payment. We know now, on that budget, granting that our income shall reach the amount set, what our gain will be, and in case it goes above or below, we will have that much more or less. Let me recommend this same system to future officers, for it takes away much worry, and is a most logical method of procedure. It precludes any possible friction between committees as they seek funds, and, for all concerned, it breeds economy in expenditure, without in any way minimizing the desired end.

For our condition, then, I would say that we are now well organized, and well financed, and the enthusiam of every constituent state association is at high tide. Let us press on toward a higher mark.

OUR FUTURE

For the future, let us think for just a moment on the subject of cooperation and its need, or rather our need of it. I picked up a short article the other day on the subject, "The Necessity for Cooperation in Religious Education," and, with a little paraphrasing, it fits into our need very well. Our principal function is educational, or the one thing essential to any man is advancement, and we advance only as we learn; therefore, something of educational value comes from all our efforts, and especially from cooperative effort. I suggest the following, therefore, for your consideration:

1. The principle of unity. "In unity, there is strength." The profession of this section cannot realize its full strength until each section knows the other. No matter how well established we may be in one locality, it will do the other no possible good until we associate ourselves. I like to think of our schools as a sort of spiritual influence among us. We have four within our jurisdiction, and as at present classified, all have a class A rating. Each of our localities needs the influence and idealism of each of these schools, and by this means we can have it. In addition, there are our fraternity and social as well as individual associations, which play a most important part in our development.

2. The principle of impact. The voice of a single one of us would not get very far in heralding the need and value of dental service; nor would it get any distance at all in raising the moral and professional standards of the profession; and as for the quality of dental service, how far would one man go alone? But we begin associating, first in our component societies, then in the state and at last in the national meeting. Now we have organized this group because our location is such that most of us cannot possibly take advantage of the American Dental Association with any degree of regularity, and this conference serves as an able substitute. We as individuals are given a wider horizon and, as state associations,

a new vision of what we can do. The impact then of this larger body is one to be felt in our local work, by both increasing its intensity and widening the field of vision and of labor of the individual.

3. The principle of efficiency. Each community comes to know what the other is doing. Individuals in one section come to know individuals in another and come also to know of their work. Do you think for a moment that this will not stimulate each to a little greater effort? If Dr. Brown in Seattle is doing the same line of work that Dr. Smith does in Los Angeles, should not each have an easy opportunity of knowing what the other is doing, as well as what those in his own city are doing? And does this not add too to the pleasure of the work?

4. The principle of economy. We might illustrate this principle by suggesting the elimination of the several state meetings for that year in which the conference is held. But I am in doubt as to the real economy in so doing, for several reasons, which I will not discuss here. It does provide a larger and better program than the local or state meetings, thus taking the place of the national meeting, to attend which cannot be afforded by all or even the majority of our members. In this, there is economy. But to me the real economy is expressed very definitely in two channels not before mentioned, research and professional literature.

A. Research. In advancing this thought to you, I do so with no little temerity, for I sometimes think that we are perhaps a little wild on the subject. We can chew more food than we can swallow. And so I often think that we have more information at hand than we are capable of assimilating. The good bishop may not have been far wrong when he suggested that a ten-year vacation be taken by those engaged in research. However, our practice and our progress depend on our knowledge and this, in turn, depends on research. This conference group might well set itself to the task of providing funds for this enterprise to be carried on by our schools. In this, we would be making a definite contribution to professional advancement in this area.

B. Professional literature. For many years, everywhere, there has been expressed the feeling that the profession should own and publish its own literature. It appears to me that we now have an opportunity to establish a periodical of our own and that now is an opportune time to do it. This thought has been expressed by several members of our conference, and I have given no little consideration to it, both alone and in discussion with others. Later, I will submit figures on cost of publication together with suggested sources of income, and will ask that you give it your thought. I will ask, though, that you add the office of editor to our group of officers and I have asked the by-laws committee to so provide, making him, however, an ex-officio member of the council.

In this, there is or may be manifest real economy, for no argument is needed as to the organization value of our state or component society bulletins — many and most business institutions have them —and such a publication as is here proposed might take the place of all of these.

And so I suggest these as possible cooperative efforts, the results of which will be increased numbers, increased information, increased friendships, and, last and most important, changed attitudes.

A change in organization has been suggested, from conference to a perfected

organization, even to the extent of incorporation. At the time of institution of the conference, the question of a name was thoroughly discussed. It was then determined that we did not wish to foist upon ourselves the constant and greater effort of another organization, nor did we wish to place another organization in the field which might thereby interfere with the harmonious operation of the American Dental Association. By considering ours as a conference, we would do just what the name indicates, meet and confer every three years and, through the conference, increase interest and membership in the national organization. I am sure that in this plan we have sufficient organization for the transaction of our business, and with the bonding of those who handle funds, we have sufficient protection. I hope that this may be maintained as a conference.

Meetings. Likewise, some of our more enthusiastic members have suggested that we meet biennially, even annually. Much of the argument set forth above would apply to this, it remaining only to add that such a plan would interfere too greatly with our state associations, and these we must hold intact. Let us not become overenthusiastic. It is always better to quit a meal a little underfed than overfed. So, in this, we are too liable to alter its beneficent office. At any rate, we are too young yet to think beyond an occasional "conference."

Dues or registration fees? Our finances are now raised from two sources: registration fees and the sale of exhibit space. The latter will, of course, always obtain. There has been some agitation concerning the registration fee, and, in some instances, a desire has been expressed that we discontinue this and collect annual dues. It has been suggested that we establish an annual payment of one dollar per member for the three year period, which would amount to nearly the sum that we now collect, and might be less objectionable. This would, to my mind, be out of the question; for all members would not and could not attend, and therefore would not get value received for the increase in annual dues. Should we inaugurate the payment of annual dues, we would be compelled to open an executive office, with increased expense. We would also find ourselves quite thoroughly organized, which I hope we will not do. The one dollar per member would provide us about the same funds that we now collect from registrations, but with increased expense, and therefore would not be sufficient. But it would be next to impossible to go into our various associations and effect this raise without a considerable loss in membership — it simply can't be done. Besides, most of us collect a registration fee in addition to annual dues; which can be easily done in this instance, and with no objection on the part of the majority of our membership.

OPPORTUNITIES

Under the heading "Our Future," I have cited two opportunities, but they pertain strictly to our internal welfare. We have a responsibility beyond ourselves, else there is no valid reason for our existence. This responsibility and these opportunities reach out into the profession, and to them I wish to direct your attention.

Our profession. Webster defines a profession as "that of which one professes knowledge; the occupation, if not purely commercial, mechanical, agricultural, or the like, to which one devotes oneself." A profession, then, is that to which our time is devoted, from which we earn a compensation, but yet which is something higher than a purely commercial enter-

prise. For us as members, our code of ethics, Sec. 7, provides: "The dentist should be morally, mentally and physically clean. He should be honest in all his dealings with his fellowman, as comports with the honor and dignity of a cultured and professional gentleman." To the fulfillment of this among ourselves, then, we should devote our first thought and energy.

The object or objects of the American Dental Association, as indicated in Article 2 of the Constitution are "to cultivate and promote the art and science of dentistry, and of its collateral branches; to conduct, direct, encourage, support or provide for exhaustive dental and oral research; to elevate and sustain the professional character and education of dentists; to promote among them mutual improvement, social intercourse and goodwill; to disseminate knowledge of dentistry and dental discoveries; to enlighten and direct public opinion in relation to oral hygiene, dental prophylaxis, and advanced scientific dental service, and in relation to the advantages and progress of enacting and enforcing proper, just and uniform dental laws in the several states; and collectively to represent, have cognizance of and safeguard the common interests of the members of the dental profession; with express power to acquire property for the purposes of the corporation by purchase, deed, gift, bequest or otherwise, and to hold and administer the same and to publish dental journals, reports and treatises."

From these, we can see quite clearly the nature of a profession, both internally as to its function and externally as to its constituency. It is not what one has, but what one knows, and if we live up to our code of ethics, it is what one is. In its constituency, dentistry has to do with laws, thus referring to the state boards of examiners, with whom the members of the profession should be in full cooperation. It is not ours to meddle with their affairs, for they are between us and the state—in fact, they are a state body. But should they come to us for help and council, we should be willing to give it. We can be of help to them and they should seek it. Secondly, we are concerned with our education, and hence should be in contact with the schools. We, the great body of the profession, or dentistry at work, if you please, know the supply and demand, and to the schools can be of inestimable help. Thus, you see the tripod on which dentistry stands.

We should not, in any degree, attempt the direct control of dental education, for this is under certain administrative authorities. I believe in university control. But in our Constitution, we are bound to "sustain and elevate dental education." Imagine dental educators not in contact with the profession. What would be the inevitable output of such schools? On the other hand, dental educators in constant contact with the profession and its educational needs know the type of training, and occasional changes therein, needed for the younger generation preparing to take our places. All that is necessary is that true interpretation shall be made, and correct information be carried to the university authorities as to the needs and desires of the profession. Here, then, lie the first of our opportunities. In line with our constitutional obligation to "sustain and elevate dental education," we find some things, which demand our attention.

A PROFESSION OR A MEDICAL SPECIALTY?

There is a definite and positive effort on foot today to wipe out dentistry and place it among the specialties of medicine, under the name of stomatology. You are

doubtless all more or less familiar with the activities of a certain stomatologic society in the east whose chief aim is that such action shall be brought about as will break up the profession which, after all these years of hard work, has been developed to the high point of efficiency now attained.

There are others engaged in this campaign, perhaps more influential, because of the relations which they have or the positions, either at present or in the past, enjoyed. Briefly, the plan is this: "(a) Certain advisory, consultive and surgical phases of dental practise should be restricted to the function of the physician; or should be based on full training for the M. D. degree, but made a specialty of statutory medical practice; (b) such procedures as filling, cleaning, and otherwise mechanically treating teeth, and fitting substitutes and appliances, should be left to 'trained mechanics' working only under the direction of 'oral specialists'; (c) the directive and prescription-writing medical practitioners of oral health-service to be 'stomatologists,' the subordinate and prescription filling technicians to be 'dentists.' " What do you think of that?

Under such control as this, what would become of the practice of dentistry? And what would be its value to those to whom it would minister? Looking into the future, what would be its destiny? Do you want to see it thus pass into oblivion, or are you desirous that we continue as a separate profession as we now are, working out our own problems, directing our own research, developing our own technical procedures, and, in full cooperation with medical practice, ministering to the needs of the public in whatsoever way we may be called on to minister? Medicine had an opportunity, once on a time, to have dentistry included within its fold, but refused to do so. My own opinion is that that was a most fortunate day for dentistry. Could this profession have been what it now is through any other means than that by which it has developed? Cover us up and split us up, and who is there to care?

My own opinion, again, is that we should be very jealous of the attainment which we have made. We must be very careful that no plan of education or of practice will spoil our unity. On the other hand, we must be equally careful that we do all in our power to "elevate and sustain the professional character and education of dentists and promote among them mutual improvement." This has been done up to the present time, but perhaps it is now time to stop and take stock, and see just what more might be done for the next advance. To deny or oppose is a negative action; to criticize without offering a remedy is destructive. Therefore, I shall ask that you give consideration to this question, and by unanimous action, if possible, take such steps as will help to thwart this nefarious propaganda, and, at the same time, lead us into higher and more useful realms.

May I recommend that:

1. We urge on members of the profession everywhere that ours is a profession the predetermined ministrations of which are second to none in need, importance and dignity.

2. Just as far as God has given us the light to see, the service which we render is as exacting and as important as any of the world's work. An engineer once said to me, "We can be off a few hundreths of an inch and it makes no difference, but you must be exact."

3. We are not in any measure ashamed to say "I am a dentist," but, on the contrary, we realize our responsibility to be

as great as that of any other man in any other line of human endeavor.

4. As individuals and as organizations, henceforth, we will turn about face, and wherever and whenever we see the opportunity, we will shake off those things unbecoming to professional gentlemen, and conduct ourselves both in thought and in action in such manner as becomes educated, professional gentlemen.

5. We urge on our schools the conduct of such courses of study as will not only make technically proficient dentists, but also turn out men and women who can think, and who will think in terms of highest service.

6. We keep constantly before us, both as an organized profession and in our schools as well, the unity of dentistry; i. e., that we shall keep all our specialties closely allied, that the best results may be had from our ministrations.

My thought in these recommendations is not of course, that you shall accept them *in toto,* or even at all; but that I shall have offered some small suggestion both as to solution and for further discussion. You may add to or subtract from; but *do something.*

Our collateral branches. Human nature is the same the world over, and I think that we as human beings are not much different from the rest of our kind. People sometimes say, "We are wholly in the hands of the physician and the dentist." To them, I reply, "We are also in the hands of the butcher, the baker and all the rest of them too." By this, I simply mean that neither medicine nor dentistry is entitled to too much criticism on account of the specialties. It is almost a common joke that one has to be able to diagnose his own case in order to know what kind of doctor to call. You know the story of the man with his right arm broken who, when he called on the orthopedic surgeon, was told to see Dr. So-and-So, for "I treat left arms only." We have not quite reached the stage of right and left side of the mouth, but we do have a considerable number of well developed specialties.[1]

Specialization is no new thing. As Weinberger,[2] in his "Evolution of the Dental Surgeon," points out: "We learn from Herodotus (500-424 B. C.), the earliest recorder of specialization in medicine, that the teeth were a separate branch of the healing art. There is an individual healer for each individual ailment, hence the whole country is filled with healers, some taking charge of diseases of the head, others those of the eye, others of the teeth. . . ." All that has been done in the years since then is to divide a little more closely. And with the accumulation of knowledge, what else could be done?

President Scott of Northwestern University recently said, "The nineteenth century has been devoted to the development of scientific facts; the twentieth century must be devoted to a study of the humanities."

With the accumulation of knowledge, the division into specialties and the concomitant development of technical procedure, people are being better served than ever before. Yet you know, and so do I, that the profession of medicine and of dentistry are today receiving a condemnation at the hands of the public to which they are not entitled. I sometimes wonder if it is not because of the inference which we may draw from President Scott's statement above. We take care of parts of the body, even of the body, but just overlook the human phase. I said to a youngster one time, "What do

1. Editorial, Hygeia, 7:714 (July) 1929.
2. Weinberger, B. W.: Dent. Cosmos, 71:516 (May) 1929.

you care—that's only your tooth?" But he retorted, "My tooth is me, isn't it?"

Now by this I do not mean that we have been or are being unkind. Yet we are pressed for time. Our patients press us for exact knowledge. We are confused with what we know and with what another may know. The result is a positiveness that may border on indifference. Only recently, I sat among a group of laymen and listened to them all but malign the practice of medicine. I answered somewhat as I have spoken just now, asking for time and evolution even to answer these questions. I repeat that we are not much different from those in any other vocation, but we cannot correct their errors—we can only handle our own. How shall we do it?

1. I have an almost unbounded faith in the science of biology, the science of life. From its study, we do not now even anticipate the good for mankind, not only the special study which the professional student of the future will receive, but the general study of all students of high school grade or over. The individual will learn what it is to live and how to live.

2. Then come the social sciences—we do not know how to live together yet. As these are pursued further and more thoroughly with future generations, the whole of society will be changed.

3. Our professional training of the future will be and even now is different. We will learn that our technical procedures are not for our benefit, but mutually for us and for those whom we serve. Dental education, while technical or vocational, must in some way teach the young man and the young woman to think. And out of their thinking will come better living and closer human relations. They will the better understand the so-called foursquare life, physical, mental, social and spiritual. And along with this will come the solution of many of those things which appear to us as problems. It is part of the process of evolution.

4. In our organized work, we must emphasize more the person. Our specialties should not branch off into organizations of their own. We must not be broken down into a polyglot of small professions. The oral surgeon must be kept in contact with the prosthodontist; the orthodontist with the children's dentist; the prosthodontist with the orthodontist, and all of these with the operative dentist. Our schools must teach the fundamentals of dentistry, leaving the further study of any one of the specialties for graduate or postgraduate work. And this is apparently the present tendency. I have recently received a communication from Abram Hoffman, professor of orthodontia, Northwestern University of Chicago, in which he refers to a paper presented before the Association of American Dental Schools, that points out the need and value of the teaching of orthodontia as an undergraduate study, and he mentions the number of favorable comments that he has received from the deans of several schools.

5. Lastly, the new learning will teach prevention, and here lies the real solution of the problem. It is both cheaper and better to be well and to keep well than to be sick.

EXHIBITORS

The commercial exhibitor occupies a place of no mean importance in our professional lives and activities, both from the standpoint of professional and educational advancement and in the conduct of our association work.

Of course, this is a mutual advantage with its corresponding gains to all parties concerned. In the work of this conven-

tion, our relation with the exhibitors has been most satisfactory, and they have presented for your consideration the most elaborate display ever shown on this coast. We hope that in it you may find what you have been looking for to make your work easier and better, and we must also hope that as an advertising medium, from their standpoint, it will prove satisfactory.

But there are a few matters which I wish at this time to discuss with you relative to our relation to our exhibitors. The demand for dentists does not come from them as a source of need. It comes from the needs of the people, from the ranks of whom come the supply. Therefore, from this, from us, comes the demand for supplies of all the various kinds, including equipment, materials, etc. We then being the commanding party should maintain the directing influence. The manufacturer, being a business man, sets about to make a certain definite percentage of profit on his investment, with an increase each year over the preceding year. This is recognized as good business judgment and practice. Hence, he is bound to try in every way to increase sales, and by whatsoever means he may, just so long as he remains within the limits of honesty.

We find the average professional man interested in his work and its improvement, and therefore open to suggestion and even direction of almost any one who can show him a trick. The result is that we have come in large measure to be dominated by those whose business and chief interest it is to sell us goods. Just to cite a few instances in which this obtains, we may note:

1. The trade houses put on clinics in casting. Their underlying aim is to demonstrate and sell the machine, which is perfectly proper. But the evil lies in the fact that we have come to look to that same source for too much instruction; which results in some loss of interest in our professional associations, confrères and the real sources of learning, the colleges. We lose our professional cast and drift into the commercialism of the merchant. They, not being scientifically trained, in other words not being dentists, give the wrong instructions, as I can personally testify. Our members return to their work with this kind of instruction, and spread harm. Questions like this one are an insult to the honesty and decency of the professional man. "Is the art of dentistry to be clouded in mystery, under the delusion that the patient doesn't care or wouldn't understand?" To me this is just high-pressure salesmanship, with no other object than to sell models. Read the rest of "Our House"[3] and then help us to bring the profession out of its lethargy, and into control of its own destiny.

2. Out of the foregoing, this has grown; namely, their too great interest in our organizations. In some instances, this has been attempted in the matter of dictation as to price for exhibit space. But the principal offense lies in this: they employ many dentists, who continue their membership in the association, with voting privileges. These men participate in all our activities as officers and committeemen, thus exercising positions of influence and leadership, leading us right along the path of commercialism, as a shepherd leads his sheep.

Owing to competition between manufacturers, and the desire of each to outdo the others, these employed dentists can do much in our "professiopolitical" field in the matter of election of officers and regarding those who may be in a purchasing office, to direct the flow of exchange. In other words, we become a

3. Pacific Dent. Gaz., 37 (July) 1929.

catspaw for their dollars in the fire. We do not have much if any of that here on this coast, but it is very evident in other sections of the country and in the American Dental Association.

3. As a result of this growth, it was suggested by a speaker for the American Dental Trade Association in Chicago, last winter, at the conference of State Society Officers, that representatives of this association be allowed to address senior students on the subject of business ethics and economics. Is it possible that there are none in our association or the academic field who can handle this?

I have just spoken with regard to the manufacturers as a whole. For further consideration, I make the following classification: 1. Manufacturers of furniture and equipment, including supplies. 2. Therapeutic or chemical manufacturers. 3. Laboratories.

Discussing each of these specifically and briefly, with the first group we have, or can have, comparatively little difficulty, provided we use our own individual heads. As far as furniture, tools and instruments are concerned, we can easily see what we want. But when it comes to the cements and similar supplies, we can note with profit their suggestion as to mixing, but we positively must not listen to their advice regarding its application.

The second group, or manufacturers of therapeutics, should rightly come in for more condemnation. Not that I am unwilling to give them their due credit, but by their very insidious activities and desire to increase sales, they are virtually educating the public and both the medical and dental professions. A pharmacist told me the other day that most prescriptions are simply orders for some manufactured product. One of the best known and most reliable of chemical manufacturers recently sent out a letter and questionnaire in which the following appeared, "Page 4 is left blank for your remarks (as to the merits of our products—parentheses mine) in the $100.00 cash offer for ideas. Your cooperation in this matter will be very much appreciated and we shall be glad to reciprocate."

The director of the Bureau of Investigation of the American Medical Association, Arthur J. Cramp,[4] has this to say:

> In brief, this business, the annual profits of which run into the millions, has grown until the use of proprietary medicines by many physicians has displaced the use of the individual official drug. It has checked advance in scientific methods of treatment, inhibited intelligent clinical observation and developed an optimism that is unwarranted by facts—an optimism that is more fatal than the most radical nihilism. But above and worse than all, this commercialized materia medica has blighted our literature by debauching our medical journals and even by tainting our text-books. And whose is the fault? That the business has developed in this country to such extent, with scarcely a protest on the part of our profession, is a reflection on the common sense and intelligence of the physicians of the United States. We, as well as manufacturers, are at fault. We must assume the blame for becoming such easy dupes to their enterprise and sagacity.

We of course do not have the same difficulty with this class of manufacturers, since we do not by any means have the extensive use for drugs. But when we stop to contemplate our increasing use of chemicals; the advertising slips that accompany all mouth washes and dentifrices, with their alluring tales of cures, and the liberal dealing out of samples that we may pass on to our patients, recommending the last or the one who gives most, surely we can recognize that there is something about it that is not of the finest order. They even laugh at us as we go away from a meeting, carrying our bag of samples. Isn't it cheap?

4. Pacific Dent. Gaz., 37:101 (Feb.) 1929.

The third group, the laboratories, have in recent years taken on a different aspect or relation to the profession, and one to which we must give earnest attention. They not only do our work for us, but are now also teaching us, and I am informed that they are preparing to add orthodontia. In that case, we can all practice this specialty, for just as we take an impression and send it to them to make a restoration, diagnosis included, so will we turn to them for the regulation of teeth.

In considering this as one of our problems, we must be wholly constructive. The laboratories are a group with whom we must labor in perfect accord and harmony. By virtue of their constant application to technical procedures, and, in many cases, to just one procedure, it stands to reason that they have perfected themselves to a degree sometimes equaling our own. Just at the present time, as I view it, there are two reasons for the apparent state of unrest. One is due to the intense competition between manufacturers of precious metals and their use of the laboratories under the guise of certification. The other is due to the combination of smaller into larger laboratories, making competition with the smaller more acute. We have not come to notice this so much in our section yet, but it is being done elsewhere. The smaller laboratories are compelled to do a variety of work while the larger ones can specialize. Therefore, competition is keener, and the smaller are not so efficient; hence, they become dissatisfied. A third reason might be included; namely, the interest that some of us have taken in the matter of licensure.

Some of whom I have made inquiry are satisfied as matters now stand. There is not a unanimous demand for licensure, though those demanding it may be in the majority. One group, I would maintain, prompted by outside influence, is apparently quite desirous, and still another feels that the only way in which to handle effectively the so-called schools of mechanical dentistry, certain laboratories and even their relations with dentists is through licensure. I wish you would give this some thought. And by way of my own suggestion, may I offer the following?

OURSELVES

As I have repeatedly hinted, I cannot but feel that our present relations with the trade side of our calling is due in the main to our own conduct or misconduct, and I therefore make the following recommendations:

1. As regards the matter of learning, let us get the notion out of our heads that we need any short cuts proposed by these self-appointed teachers.

2. Let us listen to what they may have to say concerning the merits of the materials which they are selling; but as for the application, let us go back to our original fount of learning, our alma maters.

3. Let us be the masters of our own ship and our own fate: dentistry belongs primarily to us, the dentists, and surely we have sense enough to handle it. If we are arranging a meeting and want to sell space to exhibitors, allowing a certain representation of their salesmen and demonstrators on the floor, we should be the dictators.

4. We ought to publish our own literature, thus dictating its policy. We must not be haughty or arrogant; we must be cooperative; yet we are the solicited and not the solicitor.

5. Instead of accepting the instructions of the chemical manufacturer, let us go back to our professors of materia

medica, therapeutics, physiology, chemistry, etc., and get scientific facts.

6. Let us be willing and even anxious to work. But when we send work out, just as though it were something that we are going to do ourselves, let us diagnose the case and know what is to be done. Laboratory men tell me that they have to do much of this from models sent in, before they can proceed. Likewise, they are even called in to take impressions. How can we expect their respect when we practice in this manner?

7. I am of the opinion that in most of our problems, if we will canvass the situation thoroughly and fairly, we will find that there are many corrections that we can make within our own ranks which will automatically take care of some of these things about which I have spoken. God gives us our intelligence: let's use it in getting our learning.

A SATISFACTORY METHOD FOR A COMPLETE ROUTINE MOUTH EXAMINATION*

By STERLING V. MEAD, D.D.S., Washington, D. C.

THE mouth is subject to practically as many types of disturbance as any other portion of the body and has many conditions peculiar to its own field. It is of the utmost importance that a correct diagnosis be made so that a prognosis can be given and the proper treatment instituted. While there may be various ways of treating the same disease, there can be but one true diagnosis. A thorough understanding of all of the diagnostic methods is essential for the successful treatment of any case. It is the duty of the dental surgeon to obtain full information from the patient regarding both local symptoms and disturbances and manifestations of general disturbances. The presence of oral sepsis and other mouth conditions which may affect the general health should be made known to the physician.

The examination of the mouth should not be made in a perfunctory manner: a complete examination should be conducted in a routine manner. The following method of procedure has proved satisfactory in my hands:

1. Complaint.
2. History.
3. Manifestations of pain.
4. General oral examination.
5. Percussion and palpation.
6. Exploration.
7. Color.
8. Conductivity of temperature.
9. Transillumination.
10. Roentgenographic examination.
11. Pulp testing by electric current.
12. Bacteriologic examination.
13. Histopathologic examination.
14. Blood examination.
15. General physical condition, temperature, etc.
16. Urinalysis.
17. Serologic test.
18. Differential diagnosis.
19. Treatment recommended.

*Read before the First District Dental Society of New York, Jan. 7, 1929.

In the examination of the patient, while there is no doubt of the great value of various laboratory procedures, transillumination and other recognized methods, we must not forget that symptom diagnosis is still an important factor. Many of the diseases of the mouth may be diagnosed from the standpoint of symptoms where other methods would fail. Therefore, close attention should be paid to the complaint of the patient, the history of the patient, the manifestations of pain, etc. The history should cover heredity, use of drugs, previous or present history, general habits, etc.

The general oral examination should take into consideration oral sepsis, stomatitis, lesions, growths, defective restorations, proper care of the mouth, condition of the gums, saliva, etc.

By percussion and palpation, one is sometimes able to detect pulpless teeth when no other symptom of disease is shown. By palpation over the apex of the tooth or around the tooth, a definite area of soreness may be found. Swelling, growths or lesions of the mouth or enlarged lymph glands may often be detected by digital palpation.

All surfaces of the teeth should be carefully explored for caries. Fistulas and openings in the soft tissue should also be explored.

The color of the teeth is sometimes an indication of disease. The color of the soft tissue is also an aid in the diagnosis of abnormal conditions.

Conductivity of temperature is valuable in the diagnosis of pulp disturbance. Hot and cold water may be put into the desired location with a hypodermic syringe. There are also numerous other ways of applying heat and cold.

I believe that while transillumination of the teeth and gums and mouth is generally used to some extent, the true value of this method is not well understood. The manufacturers and others have attempted to create a wrong impression regarding its possibilities and the failure to have these theories supported in their clinical experience has caused many men to abandon its use. I do not feel that transillumination shows pathologic conditions of bone. Transillumination shows soft tissue infection, and while there may also be bone disease present, it is the soft tissue infection that causes the congestion and casts the shadow, and not the pathologic bone condition.

A full mouth roentgenographic examination is advisable in every case. I prefer to make a fifteen view intra-oral routine examination and supplement this with occlusal views, lateral extra-oral views, anteroposterior views, etc., where needed. It must be remembered that a roentgenogram reveals changes in bone structure but not in the soft structure.

The diagnosis of pulp vitality by a vitality tester or electrical apparatus is of great value when used in connection with the roentgenogram and other means of diagnosis. The results obtained are often very misleading if one is not versed in this method.

The bacteriologic examination is necessary in many cases for the examination of sputum and saliva, the detection of periodontal involvements or Vincent's infection, and as an aid in diagnosis of specific infection, septicemia, etc.

Histopathologic examination is sometimes necessary. It may be necessary to remove sections of growths for laboratory examination. While this is best done at the time of operation by the frozen section method, it is sometimes impracticable and it may be necessary to remove a section of the periphery for study, which is best done by electrothermic methods. The section should be placed in a 10 per

cent dilution of solution of formaldehyd, U.S.P.

A blood examination, which is absolutely necessary in many cases, is of great value in all cases as a complete blood picture will often disclose pathologic processes and is an aid in the diagnosis of clotting and bleeding time. A knowledge of the blood pressure is very valuable when choosing the anesthetic.

There is an absolute necessity in many cases of having a complete physical examination of the patient and a knowledge of his various ailments so that his case may be handled in an intelligent way. The physical examination, of course, is in the field of the physician. However, there is one precaution often neglected by dentists. A thermometer will often save embarrassment.

The dental surgeon should make use of the stethoscope and sphygmomanometer as an aid in the selection of the anesthetic to be used.

Urinalysis is also of great value.

A serologic examination is of special value not only as an aid in the diagnosis of the patient's condition but also as a means of protection to the operator. It must be remembered that the Kahn test is indicative of syphilis in an earlier stage than the Wassermann and is rapidly supplanting the Wassermann test in many localities.

While it is not practical in every case to have all of the results outlined here before one in making a differential diagnosis, it is the ideal way and in many cases the only way. This is one of the great advantages of group medicine and of group practice. In the differential diagnosis, an analysis is made of all of the various manifestations and of the various methods of diagnosis, and by the process of exclusion, a final diagnosis, or at least a presumptive diagnosis, is made.

While it must be remembered that in such conditions as tumors, it is essential to make a diagnosis before operation, in many cases this preoperative diagnosis is a presumptive diagnosis, as the results of the operation and the pathologic report may change the final diagnosis. In other words, a growth may have the appearance of a myxomatous fibroma, cystic adamantinoma or a giant-cell tumor, and, in some of these cases, it is impossible to say definitely which of these conditions is present any more than to determine that the condition appears to be benign and seems to be one of the three conditions.

COOPERATION WITH SPECIALISTS AND THE MEDICAL PROFESSION

Many persons who come to the dentist are experiencing some systemic disturbance; and in others, while there is no systemic disturbance, there are local factors in the mouth that will evidently cause systemic disturbance. There should be close cooperation between the dentist and the physician. The dentist should stay well within his field and should recognize the physician's interest in the general welfare of the patient and cooperate with him in every way possible. The physician cannot well handle his problems without the assistance of the dentist, and the dentist is very dependent on the physician for the knowledge of the patient's physical condition.

The general practitioner should also consider the advisability of referring extractions or surgical cases to the oral surgeon when he feels the patient will profit by this procedure.

He should also refer cases to the orthodontist and periodontist when indicated.

I think that we should consider the advisability of close cooperation also with the rhinologist, the general surgeon and

other specialists in medicine. If the maxillary sinus is involved, the best results are obtained when the dentist clears his field and then cooperates with the rhinologist.

Cooperation with the physician means more than expecting the physician to refer cases to the dentist. Local mouth conditions should be reported to the physician, and the patient sent for a physical checkup. The dentist may be the first to detect symptoms of systemic disturbances.

SOME OF THE COMMON MISTAKES OF THE DENTAL PROFESSION

I think that the most common mistakes of the dental profession are the wide difference of opinion in regard to the interpretation of roentgenograms, failure to recognize the value of all of the diagnostic aids, willingness to do surgical and other work without knowing anything of the patient's general condition, condemnation of the work of others and attempting to do work which takes them beyond their field and which they cannot complete to the best interests of the patient. In many cases, the general practitioner temporizes with dangerous conditions such as acute infections and growths, not realizing their significance until the condition has reached an alarming stage.

There should be no difference of opinion regarding the roentgenographic interpretation. The film should be clear. Either the results of the pathologic processes should be shown definitely or not shown by the film, or the condition may be questionable. The imagination should not be used. In many cases, it may be necessary to have a number of views, and even then the roentgenogram may not be of any real diagnostic value in some cases. In other words, the roentgenogram should be considered as a factor only in the field of diagnosis.

There should be a more standardized or better recognized basis for selection of pulpless teeth and periodontally diseased teeth which may be treated or retained.

One of the greatest mistakes of dentists is the failure in some instances to support their profession properly. A criticism of any kind does not help the patient, or any of the interested parties, and helps to lower the dental standing of the community.

There is a widespread lack of appreciation of the seriousness of dental conditions and dental operations among the medical profession and even among the dentists. The removal of a tooth is a more serious procedure than many of us realize. There is still a prevailing attitude that an injection of procain, administration of a little gas, pulling a tooth, etc., are of no real importance, although they are dreaded. Many people express surprise that infection, shock or any complication should follow so simple a procedure as removing a tooth.

I have seen patients who successfully passed through dental operations die of other complications within a few days. Dentistry is a part of the healing art more certainly today than ever before and we are dealing with sick people. It is to be expected that some of these people will die, and the circumstances surrounding these fatalities and complications may throw suspicion on the dentist and his work, when the cause may be foreign to his field, or unavoidable even though in his field.

There should be a united effort to educate every one concerning the seriousness of dental operations, the importance of diagnosis, cooperation with the physician, preoperative preparation and postoperative care.

Dentistry is making a mistake in not attempting to give more instruction regarding mouth diseases and dental problems to medical students, endeavoring also to broaden the views of the general medical practitioner.

The general practitioner of dentistry may refer a case to the exodontist or oral surgeon, or the exodontist may refer a case to the surgeon or medical specialist, without a full knowledge of all of the difficulties and responsibility and undertake to dictate a plan of procedure. A case that is referred should be turned over with full confidence that the case will be handled correctly as the operator thinks best.

There is a general habit of performing dental operations, extractions or even other surgical procedures without proper preliminary mouth prophylaxis and hygiene. There is a widespread willingness to operate in the mouth without preoperative and postoperative roentgenograms. Serious results may often be prevented by preoperative recognition of dangerous conditions through physical examination, and by handling the so-called simple case as a major operation. The more one undertakes to treat and handle serious cases, the more responsibility he must assume.

WHAT THE GENERAL PRACTITIONER SHOULD KNOW REGARDING THE DISEASES OF THE MOUTH

The general practitioner should be able to make a routine mouth examination and he should know the entire field of his work. Where his particular type of work does not enable him to see enough of the cases of stomatitis, tumors and unusual conditions, he should be able to determine where to send the patient for further examination.

We might say that the health of the patient is often in the hands of the general practitioner of dentistry, and he may have the best opportunity for safeguarding the patient's health. He must therefore have a generalized knowledge of diseases of the mouth, their seriousness, proper diagnostic procedures, proper cooperation and consultation, and look at the patient's mouth not only from the restorative standpoint, but also from the standpoint of one of the consultants in the care of the patient's general health.

PULPLESS TEETH

In determining when to extract a pulpless tooth, it is necessary to take into consideration many factors. Each case should be handled as good judgment and experience indicate. With but few exceptions, my practice is to recommend extraction of:

1. All teeth showing evidence of periapical bone involvement.
2. All pulpless teeth in patients whose health is seriously endangered.
3. All pulpless teeth showing marked periodontal bone resorption (periodontoclasia).
4. All pulpless teeth directly bordering on the maxillary sinus.
5. All third molars when pulpless.
6. All pulpless teeth when the root formation precludes the possibility of a good root filling.
7. All pulpless deciduous teeth.

Pulpless teeth with satisfactory root fillings whose periapical tissues are roentgenographically normal, if transillumination, ocular and digital examination and symptom diagnosis are negative, may safely be retained, but they should be kept under observation from time to time.

PROGNOSIS IN PERIODONTAL DISEASE

Periodontal disease may be classified for treatment as follows:

Class I: Gingivitis; no bone resorption; no pocket.

Class II: Slight bone resorption and pocket.

Class III: Bone resorption of marked degree, but involving less than half the length of the root of the tooth.

Class IV: Bone resorption, extending more than half the length of the root of the tooth.

The prognosis for Classes I and II is very favorable. The prognosis for Class III is usually favorable for vital teeth. The prognosis for Class IV is usually bad, and extraction is usually indicated.

Other factors affecting the prognosis are:

1. It is necessary to have the cooperation of the patient in prophylaxis.

2. The patient's general condition must receive proper and careful attention and the vitality of the tissues must be restored.

3. All forms of mouth sepsis should be corrected and pulpless teeth removed if infected.

4. Where occlusion is bad and cannot be corrected, the prognosis is not good.

5. Teeth with good proximal support are more favorable for treatment.

DISEASED PULP

The pulp may be diseased without periapical symptoms; and even though partially vital, the tooth should be removed if it cannot be successfully treated.

UNERUPTED OR IMPACTED TEETH

Teeth embedded in normal bone structures should not be removed simply because of this condition, unless there is good reason to suspect them of reflex irritation or systemic disturbances. There are some cases in which these teeth are removed on symptom diagnosis in the absence of any other sign of disturbance, and recovery follows. It is sometimes advisable to remove these teeth when they endanger adjacent teeth.

Where there is pericoronal or other bone resorption surrounding these teeth, giving evidence of pathologic changes, they should be removed.

Where there is infection or irritation of surrounding soft structures, these teeth should be removed at the proper time.

ROOTS

Embedded roots should be extracted in every case, as they will sooner or later be the site of chronic osteomyelitis or an acute infection. Removal of roots is contraindicated only if the age, the health of the patient or the position of the root may lead to more harmful complications.

OTHER CONDITIONS

Teeth causing or involved in cysts or tumors should be removed, as should also teeth interfering with proper articulation, those which cannot be properly restored and those which interfere with restorations; supernumerary teeth, and temporary teeth retained beyond their proper time of exfoliation unless they have no permanent teeth beneath them.

Usually, the removal of teeth is contraindicated in the following conditions unless previously controlled: diabetes, syphilis, anemia, leukemia, hemophilia, severe heart trouble, lowered resistance, fever, sort throat, purpura, etc.

ACUTE INFECTIONS

The danger of extraction during an acute bone disease is the possibility of septicemia or cellulitis. When the removal of a tooth is indicated during an acute bone disease in order to obtain drainage, I should remove it.

Immediately after surgical work, where there is extensive infection or trauma, cold applications should be applied. Where swelling occurs, I prefer a saturated solution of magnesium sulphate on unbroken surfaces or Burrough's

aluminum acetate in infected raw surfaces. When the swelling persists after twenty-four hours, I usually prefer to change to alternating hot and cold magnesium sulphate packs, and continue over a twelve-hour period, using hot packs but a few minutes at a time. If swelling still continues, I use a continuous hot solution to endeavor to abort the condition or localize the pus.

When the localization is at or far below the angle of the mandible, extra-oral incision is usually indicated.

It is not well to extract teeth during acute involvement if the infection can be controlled by a hot saline mouth wash, and cold packs to face, or by incision and drainage. If removal of a tooth affords the best drainage for the pus, it should be removed, if this can be accomplished without too much traumatism. Removal of the lower third molar is especially dangerous during acute involvement, and this can usually best be controlled by treatment and removing the tooth after the acute condition subsides. It is well to irrigate under the flap of tissue and apply a mild antiseptic drug on a piece of cotton under the flap. The case should be seen as often as is indicated.

There can be no standardized method of handling acute infections, as they differ, but each case must be handled according to the problems presented.

Many cases of adenitis and cellulitis may be prevented by careful postoperative observation, palpating the periosteum and tissues and letting out congested blood or lancing the buccal mucous membrane where necessary.

I believe in early incision in most acute infections except in the region of the upper lip, where the pus should be allowed to localize on account of the danger of cavernous sinus thrombosis.

In operative work, we should keep the saliva out of the wounds and should not allow the use of a mouth wash too early. Too much reliance is not to be placed on drugs, a careful study should be made of the structures and infection should be carefully eliminated.

WHAT KNOWLEDGE OF DENTURE PROSTHESIS SHOULD A GRADUATE POSSESS?*

By H. V. COTTRELL, D.D.S., Columbus, Ohio

SINCE prosthetic dentistry consists of the art and science of restoration of lost parts within the mouth, a knowledge of the conditions under which the restoration must be made is inevitable and must of necessity include a knowledge of anatomy and physiology of the parts. It must include also the physical principles entering into the restoration process, and a knowledge of the materials to be used and the development of the technic required to use them.

The process of imparting this information requires in our college the use of

*The papers of Drs. Cottrell, Beckford, Hughes and Holliday were presented as a symposium.

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thirty-two didactic clock hours each year for each of the freshman, sophomore and junior classes, supplemented by formal and informal discussion of technical procedures in the laboratories of each class.

The freshmen have presented to them by the department of anatomy the fundamentals of anatomy, which are accentuated by prosthetic instruction. Thus the relationship between prosthesis and anatomy is established.

The movements of the mandible are here described. The question of articulators enters at this time, being presented in an elementary way. All technical procedures correlate with didactic instruction.

In consideration of full dentures, centric relation becomes a fundamental part of instruction, followed by the mechanics of tooth arrangement; which results in the student's having some conception of arch form and balanced occlusion. The arbitrary use of the facebow is also included in freshman work.

In partial denture work, emphasis is placed on the logical relation of clasps to anchor teeth, and discussion of the various types of clasps. A discussion of the different types of lingual bars follows. In the freshman technic, the vulcanite denture base alone is used.

The technic pieces entering into the freshman year as we group them are twelve in number and are described as follows:

1. Four compound impressions of the mouth of a student, and plaster casts made from them.

2. Two plaster-of-Paris impressions of the same student, and plaster casts from them.

3. Casts from compound impressions, retouched after comparison with those from the plaster casts.

4. Vulcanite wedge showing improper vulcanization, the surfaces of which are used to demonstrate the logical procedure in polishing vulcanite.

5. Palatal plate for student's mouth.

6. Partial upper denture carrying two or three teeth without gums. To this denture is added, by a second vulcanization, another tooth by the waxing process. The denture is then broken and repaired by the waxing method.

7. Partial lower denture with two wire loop clasps and vulcanite lingual bar.

8. Partial lower denture with two two-arm clasps of sheet metal and a metal lingual bar. This bar is built by soldering two 14 G. round wires together.

9. Partial upper gum section consisting of an incisor block and a bicuspid block, which are ground to fit the ridge.

10. Full upper plate without gum over six anterior teeth and occluded with natural teeth.

11. Full upper and full lower plates in balanced occlusion.

12. Full lower plate of this set, broken, then repaired by packing rubber with hot iron.

In using the first three named pieces in the place we do, we feel that, from a psychologic point of view, we accomplish a good thing for the student as he feels that he is doing something which has a bearing on dentistry; he cannot see that anything else that he has scheduled has such a connection.

In the sophomore year, the student's study of physiology strengthens his understanding of the tissues of the mouth in regard to their function as support for denture bases. A consideration of the principles of denture retention is included in this year.

A more complete discussion of the philosophy of the facebow and the path of the condyle enters in this year as we

approach the application of these things to clinical procedures.

The sophomore technic pieces, eight in number, are:

1. Full upper swaged aluminum plate with teeth attached and occluded with natural teeth.
2. Full upper and full lower plate with brass bases. These bases are reinforced by soldering on stiffeners and peripheral wire as well as lugs for the vulcanite attachment of teeth. The teeth are in balanced occlusion on an articulator with adjusted condyle paths.
3. Full upper and full lower gum section with vulcanite bases.
4. (*a*) Full upper cast aluminum section with vulcanite attachment for teeth.
   (*b*) Full upper Watts' metal section with vulcanite attachment for teeth.
5. Metal bases in No. 4 used by arranging teeth in balanced occlusion with condyle paths asymmetrical.
6. Metal die using cores.
7. Vulcanite splint of Gunning type.
8. Partial lower plate with cast saddles, cast lingual bar, two cast clasps with occlusal stops and stressbreaker assembled by soldering.

The junior year opens with an intense application of the technic of taking impressions for the edentulous mouth, and is continued by the consideration of the artistic phases of denture work as brought out by the restoration of facial lines and individual tooth arrangement.

A discussion of the mechanical means of restoration of cleft palate is included in this year's work. The clinical use of the wrought clasp is emphasized, together with palatal bars, and indirect retainers, etc. The continuous gum denture is also taken up in this year's discussion.

The art of soldering we feel has a vital place in the practice of dentistry, in spite of the wave in favor of casting everything which prevails at present. We, therefore, provide such metal pieces for technic in this year as we feel will thoroughly demonstrate the student's ability and develop his technic in this work. There are five technic pieces, enumerated as follows:

1. Partial upper swaged base with pin facings on anterior and tube teeth on posterior teeth, two wrought one-arm clasps, all soldered on.
2. Full upper solder swaged base, using pin facings and heavy backings.
3. Partial lower swaged base resting on retained roots with copings, using Gilmore clasps for retainer and anchored by vulcanite.
4. Partial lower swaged base, wrought lingual bar and Roach No. 1 retainers on bicuspid gold crowns. Indirect retainers on bar.
5. Full upper continuous gum skeleton, attaching but three or four teeth, but following the underlying principles of this metal substructure.

The majority of these exercises are not of such type as we use in clinical procedures, but they do contain the elements which develop technic.

It is noticeable throughout all the technical procedures that there are many repetitions of certain operations. These we believe to be important operations; hence, the repetition.

We believe with an eminent psychologist that "other things being equal, the greater the number of practices, the more permanent will be the learning process"; and, with still another, that "repetition is essential to the mastery of skill."

Quoting from a symposium of two years ago, given before this organization, I reiterate that "we aim to present these cases to the student so that each case is more or less of a problem; it should inspire thought; it should show connection

with the clinic; if it doesn't, the skill developed is mere routine."

Clinical procedures should be so numerous as to further develop this skill before the student is permitted to graduate.

Partially to determine a senior student's relative standing as to clinical work, our faculty some years ago developed, and still adheres to, a plan of evaluating operations on the basis of numerical points of credit for quantity, associated with the grading A, B, C and D for quality.

To illustrate: We give thirty-six points for a full denture on a vulcanite base, four points for a wrought clasp, eight points for a lingual bar, and fourteen points for a rebase. A minimum requirement of 400 points in plate prosthesis is made for graduation.

We reserve the privilege of saying that if it should happen that a student with A and B grades on his work has less than 400 points, he may be considered fully competent by comparison with others who have more points and less quality.

We believe in the closest personal contact of instructor and student as the best means of inspiration.

WHAT KNOWLEDGE OF DENTURE PROSTHESIS SHOULD A GRADUATE POSSESS?*

By FRED A. BECKFORD, D.D.S., Boston, Mass.

THE purpose of an education is not merely the accumulation of a vast number of facts and a wide general knowledge, but it serves also to train the individual's mind to think clearly in order to meet the different situations and problems of life. In a technical profession such as dentistry, it is also necessary that the individual's hands and fingers be trained in the skill and technic of his profession, in order to coordinate properly with his mind in the execution of the different operations required in the practice of that profession.

All dental schools should plan their courses so that, by the presentation of the proper proportion of theory and practice, students will acquire a general training enabling them to become efficient practitioners of general dentistry in all its branches. After graduation, and with some time spent in general practice, where practical experience is gained, those men who show some aptitude or interest in special work can, with the background already obtained, apply themselves to further study and practice in special fields, with the idea of becoming specialists. All undergraduate teaching then should consist of proper grounding in the fundamentals of the different subjects presented and the application of these fundamentals to the simpler problems presented in clinical work.

It is with this plan in mind that the teaching of prosthesis is conducted at the

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Harvard Dental School. Following a course given in the freshman year in dental anatomy, the men are carried through a graded course in dental technics through all the sophomore and half the junior year. At the beginning of the second semester of the junior year, the class is started on practical clinical work in the infirmary which continues for five half days a week for the rest of that year and all through the senior year.

The freshman course in dental anatomy includes the carving of cusp forms in order that the student may become familiar with these forms. It also aids in training the hands and fingers in the technical skill so necessary to his success. In this carving, students are taught, besides the forms of individual teeth, the relations and contacts of the different teeth with each other. It has always seemed to me that this course should be extended to include the study of the occlusion of natural teeth in the ideal arrangement, and the proper balancing of these teeth in the different excursions of the mandible. The relation of the inclined planes of the cusps and the depth of the cusps in relation to the inclination of the condyle path in average normal cases seem to be fundamentals which it is necessary to know before the proper restoration of these factors in artificial work is attempted. At present, this information is given in didactic lectures later on.

The prosthetic department at Harvard is divided into three sections, a full denture, a partial denture and a crown and bridge section, with a man in charge of each who is responsible for the teaching in that section. These men give the lectures and supervise the clinical work pertaining to their subjects. They also direct the arrangement of the technic course so that it will coördinate with the clinical teachings. No lectures are given during the technic course, but daily conferences are held by the demonstrator in charge of technic. These conferences are held in conjunction with his demonstrations and are all reviewed later by the professors in their lectures on the practical application of the principles involved.

The technic course starts in January of the sophomore year and continues daily for the rest of that year, or a total of 182 hours. This is taught by frequent demonstration and conferences by the demonstrator and his assistants. All the necessary steps and principles involved in the different constructions are explained and demonstrated, and the student repeats all the work for a stated number of specimens.

These specimens for the sophomore year cover all full and partial denture construction. The manipulation of impression materials, the construction of baseplates, the arranging, occluding and balancing of teeth on an adaptable articulator and the proper vulcanization of rubber are carefully taught. In the partial denture field, the casting of bars, the bending of clasps and the construction of all framework and its proper heat treatment give the student the necessary experience for his clinical work. These specimens are all completed at the end of the sophomore year.

For the first three months in the junior year, the student continues his technic by construction of the crown and bridge specimens. This is carried on by the same staff of instructors in the same way as before, for 144 hours. In this way, each student will have spent a total of 326 hours in technic, which should give him a thorough understanding of all principles involved, and will have devel-

oped skill with his fingers to a point where he can be trusted to work in the mouth.

So far, attention has not been called to the handling of soft tissues in the impression technic except as it is alluded to in designing the dentures. I refer to muscle trimming and tissue compression. These are carefully explained and demonstrated to the student on his first work on a patient. We feel that this can be better taught under actual working conditions on living models than by an imitation of the factors on a manikin. This first impression work is done on the student himself by another student. The men are arranged in pairs and each must take a plaster impression of his partner's upper and lower jaw, assemble it properly and make suitable casts. This is supervised by the instructors, who insist on great accuracy. This experience teaches the student how to handle a patient and gives him practice and confidence. It also teaches him something from the patient's point of view and should make him more gentle and considerate. It further teaches the proper manipulation of impression plaster and how to estimate its average setting time at body temperature.

At the beginning of the second semester of the junior year, the student is given his first work in actual practice. This is to continue for five half days a week during the rest of his course, a full year and a half, or until he is graduated. The work is graded as far as possible, the beginners being given the simpler cases, such as a full upper or an easy partial denture. As the student progresses, he is given more difficult or complicated cases as they are presented to the clinic. A careful check is made of the work each student does so that each man will have had experience on all the different varieties of prosthetic restorations. During all his work, he is constantly supervised and aided by the clinical instructor, who demonstrates to each individual the necessary procedures. The class is so divided that each instructor is in charge of not more than eight men, which insures almost individual attention for each student. Each step in the construction must be signed by the clinical or the laboratory staff before the next step is undertaken. In this way, the instructors themselves are responsible for the successful termination of the case as well as the actual teaching of the student. During the last year, with a class of only forty-eight seniors and thirty-three juniors, cases were completed as indicated in the accompanying table.

CASES COMPLETED IN ONE YEAR

	Seniors	Juniors	Total
Full plates	346	67	413
Partial plates	152	14	166
Full gold plates	3	0	3
Partial gold plates	27	0	27
Plates repaired	101	61	162
Cast clasp bridges	15	0	15
Fixed bridges	42	0	42
Porcelain crowns	10	3	13
Metal crowns	35	0	35

During the last half of the senior year, further instruction is given in the following manner: Each morning, two seniors are assigned to the diagnostic room, where, under the supervision of the instructor in charge, all new patients are examined. The students diagnose each case as presented, planning what teeth should be extracted or retained and what type of restoration should be made. This is approved or corrected by the instructor, who points out any unusual condition or difficulty and suggests the solution of the problem presented. In this way, the student is taught to think for himself and to meet conditions as they will arise later on in his private office. After examining all the new pa-

tients, the student goes through the clinic to see the different cases being constructed by the other students, listens to instruction given them, observes their mistakes, if any, and is quizzed by the instructor on the different procedures. In this way, each man sees a larger variety of cases than he would if limited to his own work, and profits by the mistakes of others. This procedure has proved very valuable in Harvard in developing judgment and initiative.

Toward the end of the course, each senior is given a state board case, so-called because he is allowed to show it later to the state board of registration as a sample of his work. This case he picks from the clinic and diagnoses, designs and constructs without help or suggestion from any instructor. On the finished result, his final grade is based, his mechanical skill and esthetic judgment being taken into consideration. For the last few years, no man has yet failed in this test.

The theoretical lectures are given in coordination with the practical work in the clinic, from its very beginning. These one hour exercises are given by the heads of the three branches of prosthesis. Divided equally between the three sections of the department, there are two lectures given each week for a total of twenty-four in the junior year and forty-eight in the senior year. In these lectures, the fundamental principles of prosthesis are reviewed and explained, and their application to the conduct of prosthetic practice is stressed. In the full denture section, the principles and physics of retention, the construction and application of different bases, the occlusion and balance of artificial teeth and the importance of the use of an adaptable articulator are the high points brought out. In the partial denture field, the problem of proper design of the denture, its retention by proper clasp design and construction and its final physiologic basing are the important features. The choice of proper metals and alloys and their tempering or heat treatment is carefully considered. In the crown and bridge section, the first consideration is the conservation of tooth structure and the maintenance of the health of the supporting teeth and roots under the stress and leverage to which they are subjected. The choice of abutments and different forms of pontics is carefully studied and applied to the practical cases in the clinic. A description of some of the complicated systems of removable bridges, such as the Chayes system, is given, but no attempt is made to present these cases in the clinic, as they are considered postgraduate work.

In addition to this presentation of the theory of prosthesis by lectures, the students have an opportunity to gain further knowledge by individual study under the direction of a tutor. This tutorial system has just recently been inaugurated at Harvard. The class is divided into groups of five, each group being given a subject for study under the direction of a tutor assigned from the teaching staff. The tutor meets the group at regular intervals and directs their reading and study. Each student then writes a thesis on this subject; the best one of the five is selected, and its author reads it to the whole class. The other four men in the group who have studied the same subject are then asked to discuss the paper. In this way, the whole class benefits from the study of these different subjects. The subject from the prosthetic department for this year is "The history of occlusion, with special reference to the study of the temporo-

mandibular join and a reproduction of its movements by an adaptable articulator."

With this training, a senior ready to be graduated will have had a careful intensive course in technic which will make him familiar with all the different forms of prosthetic construction. He will have had a full year and a half of regular daily practice in practical work which should give him skill enough to attempt any type of case that he will meet in practice. And, in theory, he should have a thorough understanding of all prosthetic principles and fundamentals and their practical application and also the biologic reactions of the living tissues to which his restorations are applied.

WHAT KNOWLEDGE OF DENTURE PROSTHESIS SHOULD A GRADUATE POSSESS?*

By F. C. HUGHES, D.D.S., Indianapolis, Ind.

SINCE it is impossible for a student to be overly proficient and since he certainly needs all that we can give him in the way of training in denture prosthesis, the question really resolves itself into "In how small a measure may the student possess the qualities above mentioned and still be permitted to graduate?"

How may we best impress the student mind with the fundamentals of denture prosthesis and what system of measurements may we apply to our graduates to determine the success or failure of our efforts?

Were I to attempt to give a brief answer to the question propounded in the subject of this symposium, it would be somewhat as follows:

The dental student at graduation should be sufficiently well grounded in the theory and practice of prosthetic dentistry to be able to cope with the ordinary problems of practice successfully. He should have developed himself sufficiently to overcome the mental hazards incident to such problems and, lastly, should have acquired the desire and ability for continued postgraduate study and development.

THEORETICAL KNOWLEDGE

As thorough knowledge of a problem must come before its successful solution, so must the dental student be well grounded in theory before he can successfully deal with the technical problems of denture prosthesis.

Freshman students in our school are given thirty-two hours of didactic instruction in prosthetic dentistry. The freshman lectures begin with a presentation of definitions and historical data relative to prosthesis and continue with the study of materials.

The lectures and technic assignments should be so timed that the knowledge gained in the former may be utilized in the latter. While an effort is made to cover the entire subject of full denture

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work in the freshman year, it is done only in an elementary way, in order to avoid befogging the student's mind with complicated theories before he is ready for them.

Sophomores have one hour a week of didactic instruction in prosthetics. The first semester is devoted to a detailed presentation of the technical aspects of full denture prosthesis. The second semester is taken up with a consideration of partial denture construction. Juniors also have a one hour a week lecture course, which involves a consideration of the anatomic and mechanical problems of denture construction, with particular attention to diagnosis and prognosis.

The senior class is given one lecture a week, which is intended to be a review of all the prosthetic problems presented in the former years. The individual problems encountered by the students in the clinic are also discussed in the classroom. Senior students are encouraged to hand in questions relative to denture construction. Some periods are taken up in discussing the questions which seem to be in the majority. The course closes with a presentation of proper methods of handling denture patients in an office practice and a discussion of abnormal cases.

Our classroom work in all four years consists of lectures, presentation of lantern slides, demonstrations, quizzes and written tests. In the senior year especially, we like to promote student discussion in the classroom. In an effort to stimulate study, we prepare a list of pertinent questions and give them to the class a week before the time when the answers are required.

Briefly speaking, a student's theoretical knowledge should embrace a thorough understanding of the diagnosis, prognosis and treatment of edentulous cases as far as can be taught in the classroom. The student must be taught to develop a purpose and confidence in his ability to accomplish it.

TECHNICAL SKILL

We observe a great difference in the technical skill of the individual in a group of students as we watch them work in the laboratories. Early in their college career, we are inclined to classify them mentally into three groups. First, there will be the great majority of them whose technical skill is of average quality. Then, there will be a small group whose ability stands out as markedly superior to the average. Lastly, there is the group whose work is poor and who require constant coaching and supervision throughout their entire school career, and even as they graduate, we are often inclined to wonder whether we did the right thing in passing them.

Of this last group, there are some who will not be qualified to graduate, no matter how great the efforts of their instructors. These students should be weeded out early in their college course, and our skill in picking them out has quite a little to do with our success as dental teachers.

In spite of the increased emphasis which is being placed on the scientific aspects of dentistry, technical skill must always play an important part in the successful practice of our profession, and the development of the student's manual dexterity must always remain a large share of the duty of the dental teacher.

While it is necessary to have a standardized course or system for carrying this knowledge to the student, we must expect to deviate from our regular system in certain cases. In other words, knowledge must be administered in an assimilable form. A few minutes spent in individual instruction with a backward student is

often worth more to him than several hours of class instruction.

Freshman students in our school are required to spend 320 hours in the prosthetic laboratory. The work covered in this course is of an elementary nature, designed to develop the student's digital deftness and prepare him for the more intricate problems to follow. The work begins with a study of materials used in impression and cast making. Following are assignments in the working of plaster of Paris and modeling compound, with particular attention to proper manipulation. The first exercises with plaster of Paris consist of making specimens of various sizes and shapes, which involves practice in mixing, molding and cutting the material to specified designs and measurements.

Assignments are also given at this time in the manipulation of rubber, flasking, packing, vulcanizing and polishing various specified designs. After the preliminary work, which requires most of the first semester, the student is given assignments involving the making of impressions and casts and articulator exercises. Hanau manikins are used to represent the patient in the work. I might say in this connection that we use the Hanau articulator in all our technic and clinical work in denture prosthesis.

The freshman course is completed by the construction of two full upper and lower dentures, vulcanized and finished. Alinement and symmetry only are taught in these cases, the more complex problems of condyle adjustment and balanced articulation being left for the sophomore year.

In the sophomore year, three hours a week are devoted to denture technic. The work consists of the building of five full upper and lower dentures, four to the point of flasking and one vulcanized and finished. These cases are built on Hanau articulators, the manikin representing the patient. Each case is built to different condyle registrations. Different degrees of overbite and overjet are taught, as well as a variety of arch forms. Each student is assigned a manikin, the readings of which must be reproduced on his articulator, and each case represents a different problem in articulation. This gives the student experience in utilizing the laws of articulation. Students are given technic tickets on which are written the various stages for having their work checked by the instructor. The following stages for passing are assigned:

1. Impressions.
2. Impressions box ready for pouring.
3. Casts.
4. Baseplates adapted.
5. Occlusion and contour models.
6. Facebow adjusted on manikin.
7. Upper cast mounted in articulator.
8. Registration of centric relation.
9. Lower cast mounted in articulator.
10. Protrusive and lateral registration of condyle setting.
11. Teeth arranged and checked on manikin.
12. Wax model dentures waxed and carved.
13. Dentures flasked.
14. Flasks separated and rubber packed.
15. Dentures vulcanized.
16. Dentures polished.
17. Remounting and regrinding in articulator.

Like the sophomores, the juniors are required to spend three hours a week in the prosthetic laboratory. Their full denture technic consists of two full cases, vulcanized and finished. In one case the occlusion rims are built on a vulcanized base. This permits making the various

registrations on vulcanized rubber rather than on the hard wax base. As the student progresses from one technical assignment to the next, the instructors become more critical, and increasingly greater degrees of perfection are required in the work. The stages for passing the work in the junior year are the same as in the sophomore, but each step is expected to demonstrate an improvement in the student's former effort.

The time devoted to full denture technic by the seniors is three hours a week for one semester. Full upper and lower dentures are required, being checked at the various stages of construction as enumerated above.

It has been suggested that possibly we devote too much time to full denture technic, but we feel that any reduction would react to the detriment of the student. You will note by the foregoing outline that the assignments in denture technic are distributed throughout the entire college course rather than emphasized in any one year.

It is our intention to have the student devote some of his time each week to full denture work. He should be made to understand the value of time, taught that it is a "commodity" which he cannot afford to waste.

PRACTICAL EXPERIENCE

Broadly speaking, a student at graduation should have had sufficient work in practical denture prosthesis to give him a working knowledge of at least the normal problems.

Obviously, it is impossible to expect each student to have clinical practice involving all the intricate problems incident to abnormal cases.

At Indiana, the average student devotes approximately 300 hours to denture prosthesis in the college clinic. This includes the time spent in partial denture construction and repairing artificial dentures.

Each student constructs an average of four full upper and lower practical cases during his junior and senior years. This involves practical experience in:

1. The diagnosis and classification of edentulous cases.
2. Impression and cast making. In this connection, let me say that we are giving the student instruction in both the full compound and the combination plaster and compound impression technic.
3. Building of occlusion rims on vulcanized bases, making various registrations in the patient's mouth and transferring to the Hanau instrument.
4. Selection and arrangement of proper hue and mold of artificial teeth and checking in patient's mouth.
5. Carving, tinfoiling, flasking, packing, vulcanizing and polishing.
6. Final check in the patient's mouth, including correction of errors by remounting and regrinding on the articulator. This final correction technic includes remounting the finished case with the facebow and setting the articulator according to new protrusive and lateral jaw registrations made after the case has been vulcanized.

The student is not given final credit for the work until he has had several appointments with the patient subsequent to the insertion of the dentures. These appointments, which are made over a period of from four to eight weeks, give the student valuable experience in helping the patient to accustom himself to the new dentures and enable the student to better appreciate the result of technical errors.

Of late years, we have endeavored to give senior students practical experience in what we term treatment cases, consisting of a series of dentures constructed

over a comparatively short period, in an effort to teach restoration of lost facial dimensions.

We pay particular attention to diagnosis and record keeping in our clinic instruction, as in this way only are we able to teach prognosis and denture design as well as showing the students the results of their work.

SUMMARY

Our first efforts should be to impress on the student mind a picture of the finished result desirable in normal denture cases. This impression or mental picture, the theoretical part of our work, is developed by lectures and demonstrations in the classroom. Every effort must be made to have these first impressions correct, as no amount of technical skill will compensate for a discordant mental picture.

Once the correct ideas are formed in the student's mind, our next task is to teach him to incorporate these ideas or pictures in his technical work. Considerable repetition of the more important assignments are necessary. The student should come into the clinic to begin his practical work with a fairly good understanding of the fundamentals of denture technic, especially the selection, arrangement and articulation of artificial teeth.

Through all phases of the student's work, the value of study and investigation should be stressed. We must keep him from becoming satisfied with his efforts.

Had I the power of conferring any number of desirable traits on the dental student and I was limited to one choice, that choice would be an ardent desire for continual postgraduate study and development.

COURSE IN DENTURE PROSTHESIS GIVEN AT THE MEDICAL COLLEGE OF VIRGINIA*

By G. W. HOLLIDAY, B.A., D.D.S., Richmond, Va.

DISCUSSION of the subject "What Theoretical Knowledge, Technical Skill and Practical Experience Relating to Denture Prosthesis Should a Graduating Dental Senior Possess?" could not possibly be controlled better than to confine the essayists to brief summaries of the theories taught, technical training given and practical work done.

In our school, we consider an adjustable articulator essential. The intraoral method is employed, with the Hanau facebow and articulator. Balanced occlusion is the ultimate aim, and the means by which it is obtained in denture prosthesis, whether in full or partial dentures.

The course of training in denture prosthesis naturally falls into three divisions: the didactic (or theory), the laboratory courses and the practical work of the infirmary.

DIDACTIC COURSES

Freshmen.—In the freshman year, second semester, sixteen hours are given to lectures and demonstrations on the fundamentals of the various materials, such as plaster, compound, wax, rubber.

*Read before the group conference on Denture Prosthesis at the Sixth Annual Meeting of the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

gold and its alloys, and their uses, together with the principles of vulcanizing, swaging, casting, soldering, polishing, impression taking and pouring models. No text is used.

Sophomore.—In the second year, the lectures and demonstrations include the physical properties of materials and their uses, and outlines of procedure in the construction of full and partial dentures. At the present time, the sophomores are using Wilson's textbook on prosthetic dentistry. One lecture a week is given throughout the year or thirty-two lectures.

Junior.—For the juniors, the didactic work consists of lectures, lantern slide demonstrations and table and chair clinics. In partial dentures, the course is designed to teach the fundamentals in the construction of only the simple cases.

On full dentures, a detailed outline of the procedure used in the infirmary is given, step by step. Stress is laid on the importance of an adjustable articulator and its correct use.

Students are required to take notes. No textbook is used. One lecture a week is given throughout the year, or thirty-two lectures.

Senior.—In the fourth year an effort is made to cover all the prominent theories on the designing of partial dentures. Special stress is laid on the indications and contraindications for the various types of retainers. This is done by lantern slides, table clinics and demonstrations of practical cases from private practice by the lecturers in charge. Cummer's charts are used to illustrate designing. One lecture a week is given throughout the year.

On full dentures, the lectures cover a brief survey of the field, with especial attention to recent developments, but are confined principally to complications in practical cases, such as close bites, crossbites, abnormal relations of the jaws and irregular condyle paths.

In order to stimulate an interest in dental literature, students are assigned reading in the current journals on which to report in class. They are also assigned subjects on which they are required to prepare a thesis of at least 1,000 words. Lantern slides and charts are also used. The course is covered in sixteen lectures during the first semester.

In all didactic courses, one written quiz is given each semester. A written examination covering the course is given at the end of the year.

TECHNIC, OR LABORATORY COURSES

First Year.—The course in dental technic is designed to acquaint the beginner with the manipulation of dental instruments and materials. The instructor in charge demonstrates the technic involved in each step of the various operations. Technic models are also kept on display in the laboratory to illustrate the work.

Each piece of technic work requires a certain order of procedure. The steps in order of construction are copied by the student on technic cards furnished for that purpose. As each step is done satisfactorily, an instructor passes on it and punches the card. As each piece of work is done, it is filed away with the card in a box supplied each student by the school. Each box is large enough to contain all the technic work of a student. The college is custodian of the boxes until the students graduate, or transfer to another school.

The periods are two hours and these are three periods a week through the second semester, making a total of ninety-six hours.

Second Year.—The sophomores begin their training in the process of construc-

tion. Their training in the manipulation of the materials in the previous year enables them to proceed with little difficulty.

They have three guides, or means by which they learn to proceed: (1) the technic card with each step in order of the procedure; (2) models illustrating the steps, and (3) individual instructions by the instructors in charge.

The periods are two hours each and there are four periods through the first semester, making a total of 128 hours.

In the second semester, the course is devoted to prosthetic technic entirely, with only two periods a week; a total of sixty-four hours.

Third Year.—The prosthetic technic course for the juniors is designed to train in designing and constructing partial dentures, together with the technic for using the adjustable articulator with the facebow to obtain balanced occlusion in full dentures. For the latter, the manikin made by the Hanau Engineering Company is used. Each student owns his articulation material.

The periods are two hours each and there are three periods a week through the first semester, making a total of ninety-six hours. This course is intended to precede the practical work of the infirmary.

Fourth Year.—No technic courses are given in prosthetics to the seniors.

PRACTICAL WORK

In infirmary practice, we adhere closely to the intra-oral method using the facebow and articulator made by the Hanau Engineering Company. Each student uses his own instruments.

In the construction of partial cases, the facebow and adjustable articulator are used as for full dentures.

On the first visit, the student is required to fill out a diagnostic chart, which includes a general history, and a record of facial profiles, the complexion and all oral conditions. They also discuss with the patient the advantages and disadvantages of the different denture base materials, quoting the fee for each. An instructor then checks over the diagnosis with the student and issues materials. From this point on, the student follows the outline on the chart, having an instructor to inspect and pass upon each step.

The student is required to do all the work on a case assigned him and is held responsible for its success. He is not given credit until thirty days after its completion. He is required to follow up the case and to make such alterations as are deemed necessary by the instructor.

In every step of the work, even the juniors are required to make an effort before an instructor offers assistance.

Students begin practical work in their junior year. Sufficient time is allowed at the first of the year for special lectures and clinics to acquaint them with the general routine before they are assigned patients. In prosthetics, this usually requires about two months.

The juniors are required to make one partial denture and three full dentures (two of which are made together as a full upper and lower denture) and to repair two.

They have ten hours a week in the infirmary the first semester and seventeen hours a week the second semester, a total of 432 hours.

Fourth Year.—The seniors are thrown more on their own responsibility; that is, they are allowed to proceed without having every step inspected. This gives them an opportunity to prove themselves either capable or incapable. They are required

to be at least 80 per cent efficient to pass on infirmary practice.

The requirements for the fourth year are: one all gold partial denture, one partial denture with gold skeleton and vulcanite base, five full dentures, and repair of from three to five.

Seniors have infirmary practice twenty-two hours a week through the year, a total of 704 hours.

AN ANALYSIS OF THE WORK AND IDEAS OF INVESTIGATORS AND AUTHORS OF RELATIONS AND MOVEMENTS OF THE MANDIBLE

By RUPERT E. HALL, D.D.S., Chicago, Ill.

BEFORE discussing the development of the construction and movements of articulators, it is deemed necessary first to study the work and ideas of the investigators[1] and authors[2] that prompted the development of the articulator and led to the ultimate perfection of a fully adjustable and adaptable instrument, solving the problem of reproducing relations and movements of the mandible. In so doing, we will understand just what inspired designers[3] of articulators to express in their instruments certain new principles, with regard to both construction and movements.

Study of the positional relations and movements of the mandible logically comes before consideration of the mechanism for their reproduction is in order for discussion, execution or use. This paper has to do only with the study of mandibular relations, movements and registrations, and not with the construction and movements of articulators, except as far as reference is made to the latter for the purpose of showing by whom and in what way certain relations and movements of the mandible were conceived and demonstrated.

With the information gained through this paper, we will be better able to interpret and more intelligently discuss the construction and movements of articulators together with the claims made for each by the designers, manufacturers and sponsors of the instruments to be analyzed in my "An Analysis of the Development of the Articulator Together with the Claims Made Therefor by Different Designers, Manufacturers and Sponsors."

Guerini[4] gives credit for the original invention of the articulator—a simple hinge movement known as a plane line articulator, an example of which is shown in Figure 1—to J. B. Gariot. This instrument was constructed in about the year 1805.

From the foregoing, we assume that Gariot was also the first investigator of mandibular relations and movements.

1. Investigators are those who first described relations and movements of the mandible.

2. Authors are those who first registered relations and movements of the mandible.

3. Designers are those who originated articulator construction for reproducing relations and movements of the mandible. A paper on the work and ideas of designers will appear in a subsequent issue of THE JOURNAL.

4. Guerini, Vincenzo: Historical Development of Dental Art, Dent. Cosmos, 43:8 (Jan.) 1901.

In 1840, Daniel T. Evens,[5] of Philadelphia, obtained a patent for an articulator which he described as "an instrument so constructed as to imitate the motion of the lower jaw, and to exhibit the actual relationship of the upper and lower teeth and gums to each other in the most perfect manner." (Fig. 2.)

As the Evans instrument was the first to embody protrusive and lateral movements, we may assume that Evans was the first investigator to call attention to the protrusive and lateral movements of the mandible.

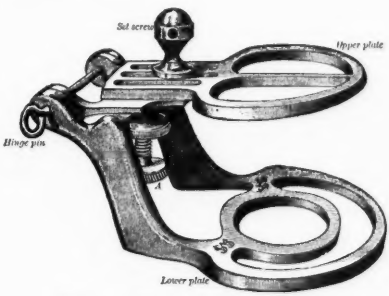

Fig. 1.—Plane line articulator.

In 1858, W. G. A. Bonwill,[6] of Philadelphia, evolved his "triangle hypotheses," conceiving, as it were, the first theory regarding the design of the masticatory apparatus and of the movements of the mandible.

BONWILL'S FOUR INCH EQUILATERAL TRIANGLE HYPOTHESIS

Figure 3 shows the triangle as used by Bonwill in his work and teachings.

Bonwill's theory was based on the assumption that the distance from the crest of one condyle to the crest of the other condyle was equal to that from either condyle to the contact point of the lower central incisors, and thereby an equilateral triangle was formed with the sides measuring an average of 4 inches according to his measurements. The line connecting the condyles he considered the base of the triangle, and the lines connecting the condyles with the contact point of the central incisors, the sides of the triangle. The apex of the triangle (contact point of the central incisors) has since been called and now goes by the name of the incisor point.

In discussing his articulator, Bonwill stated:

> Let me now for the first time tell my critics that if they would know the truth, without sectional prejudice, let them grasp the *upper cast* in the Bonwill articulator and *move* the *lower*, and they will soon see that the dip down and forward at the glenoid fossa agrees exactly with the depth of the overbite (Fig. 4).
>
> It will be observed that in making the natural movement of the lower jaw to the left, the condyle of the left side stands still or does not move forward, it merely revolves or rotates in the socket, which is but a trifle. The right condyle moves forward and downward in the glenoid cavity one-eighth of an inch, when at its farthest limit.

In spite of Bonwill's claim that his articulator registered the downward movement of the condyles, his instrument has never been regarded as reproducing this movement.

As Bonwill interpreted his geometric demonstration of the movements of the mandible, the centers of the condyles were the centers for the lateral movements and the center (axial line) for the opening and closing movement was also the center of (passed through) the condyles (condyle cord).

Bonwill was the first to relate the cusps and incisal edges of the teeth to a plane, and it appears that to him credit

5. A "Dental Articulator Patent, No. 1743," was granted to D. T. Evens, Aug. 28, 1840.

6. Bonwill, W. G. A.: Scientific Articulation of the Human Teeth as Founded on Geometrical, Mathematical and Mechanical Laws, Dent. Items Int., 21:617, 873, 1899.

is indirectly due for the term "occlusal plane" of the teeth.

Balkwill,[7] in 1866, was the next investigator to make observations on mandibular relations and movements and to discover new relations and movements. In fact, Balkwill illustrated or described every movement of the mandible known today except the backward horizontal, backward and upward and backward and downward movement of the condyle on the working side and the arcuate (central axis) lateral movement.

Fig. 2

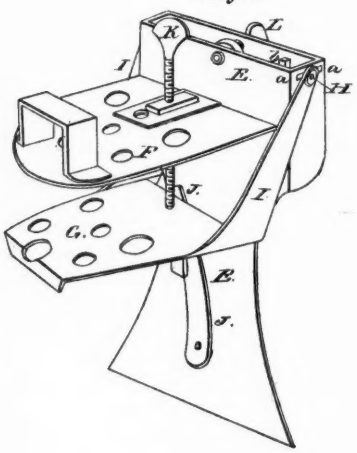

Fig. 1

Fig. 3

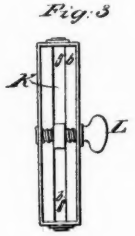

Fig. 2.—Evens' articulator.

Little has been known about Balkwill's work and ideas. The illustrations and quotations following are the first and only publication of which I know outside of the original by Balkwill himself in the *Transactions of the Odontological Society of Great Britain.*

Mr. Balkwill presented a paper on the subject "The Best Form and Arrangement of Artificial Teeth for Mastication," from which I quote:

> Having felt dissatisfied with the masticating efficiency of such dental substitutes as have either been fitted by myself, or otherwise come under my notice, I have for some time been paying attention to the means of making a more successful dental apparatus. The results of my observations and experiments I have ventured to make the subject of the following paper.
>
> The first idea which occurred was to imitate the form of the natural organs as nearly as possible; but this was found more easy in theory than practice; often, from inaccuracy in the bite, the patient complained that his teeth jarred whilst eating, the cusps of the lower piece getting entangled in those of the upper, and they had to be cut off.
>
> Like the contrivance of an ingenious Chinese blacksmith, who wished to purloin a valuable English lock left with him to repair, and substituted for it an imitation of his own, so well done that the fraud was only detected by the owner finding the machine would not lock; so the teeth might look very natural, but they would not bite.
>
> Looking from above, the articulating posterior outline of the condyle of the lower jaw appears formed of parts of two circles. The

7. Balkwill, F. H.: The Best Form and Arrangement of Artificial Teeth for Mastication, Tr. Odontol. Soc. Great Britain, Vol. V, 1865-1867.

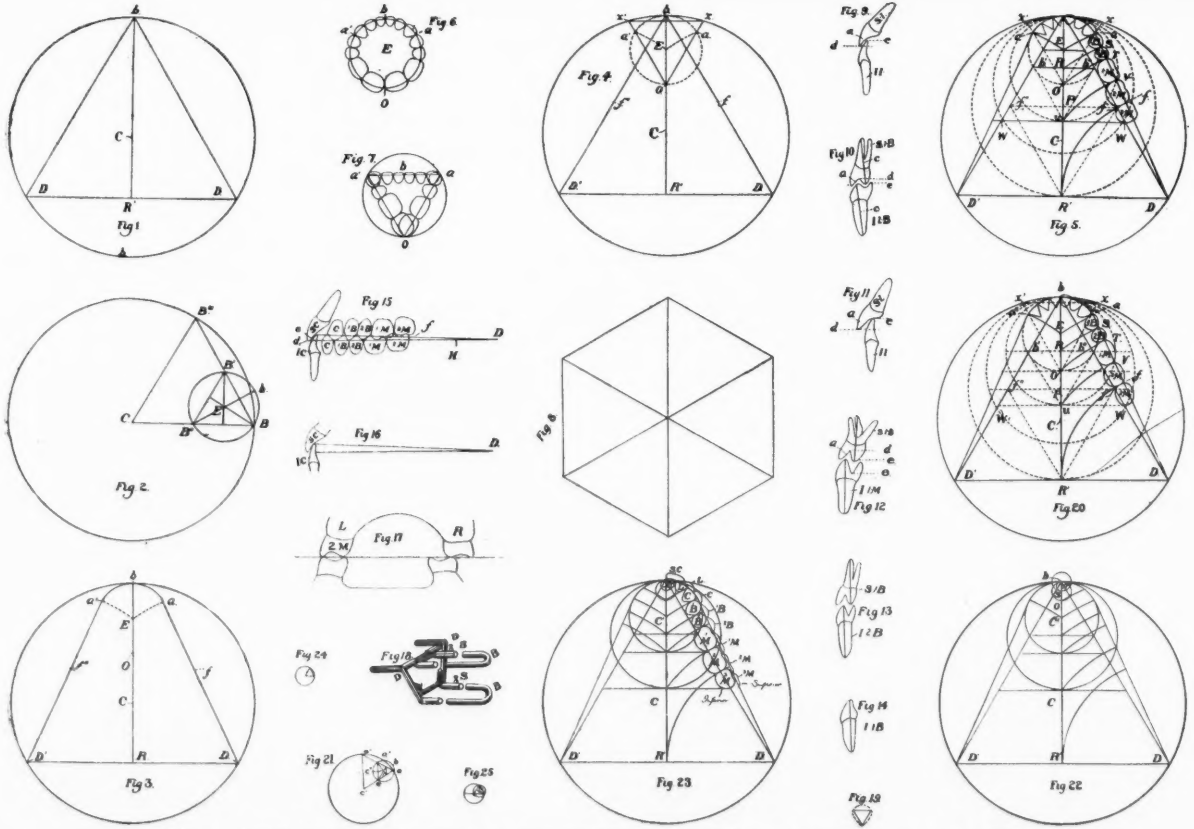

Fig. 3.—Bonwill's triangle theory of the movements of the mandible and arrangement of the teeth.

inner and larger forming part of the same circle as the symmetrical part the other side: the outer small curve forming part of an independent small circle. (Fig. 8.)

A side view shows that the condyle articulates with the glenoid cavity so as to allow of a simple hinge-like motion, and a forward and backward motion.

Placed immediately in front of it, just under the commencement of the zygomatic arch, is a ridge which has the effect of depressing the back part of the jaw in its forward motion. (Fig. 5.)

The lower jaw is possessed of a combination of both horizontal and vertical motion, levators of the lower jaw passing, from its back part, backwards and upwards to the skull, will give, as the most powerful mode of accomplishing this, that the jaw be depressed, brought forward, closed and brought backwards and upwards. In this passage, from before backwards, but for some provisional arrangement, there would be great danger of the upper cusps being entangled in the lower, especially as, from circumstances to be hereafter explained, the points are not exactly equidistant or reciprocal, there being more in the lower than the upper jaw.

The further back, from evident reasons of leverage, the greater the power, therefore,

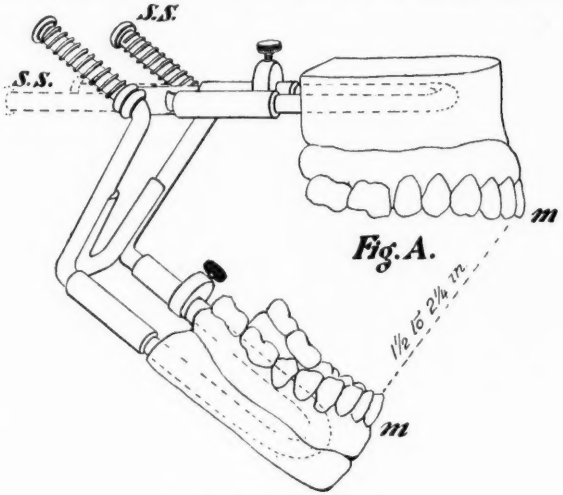

Fig. 4.—Bonwill articulator.

which it will be convenient to consider separately.

When the teeth are shut, the condyle lies at the back of the glenoid cavity, where, the front of the lower jaw being depressed, it turns like a hinge. (Fig. 5.)

Looking at the jaw from the side, the teeth present a series of cones which so nearly alternate or lock when the mouth is closed, that it will be best, at present, to consider them as doing so.

The application of these cones to food will be most penetrating, if they close so that the points meet first, and they then slide into their places. The position of almost all the the more obtuse may be the points of these teeth; and by thus lowering them there will be less danger of their clashing. To make a still further margin for comfort, and at the same time allow a wider opening at the back of the mouth than a mere ginglymoid action of the joint would give, there is, in front of the glenoid cavity, a prominence which has the effect of depressing the back part of the lower jaw when drawn forward by the pterygoid muscles. (Figs. 6 and 7.)

But this depression would not affect the under teeth relatively to the upper unless the plane of the teeth formed an angle with the line of depression; which consequently we

find in construction. (Fig. 5.) It is not practicable to measure this angle in the living subject; but I have here an instrument for measuring the angle formed between the plane of two lines drawn from the articulating surface of the condyles to the top of the front lower teeth, and the plane of the teeth, which is near enough for use. Out of a few observations I find this angle to vary from twenty-two to thirty degrees. An arrangement also giving greater power to the muscles by allowing them to act more at right angles to the general plane of the teeth.

This contrivance at the back, and the lower canines closing anteriorly to the upper in front, obviates any danger of jarring; the eater in closing his teeth gets his lower canines against his upper, and all the rest must fall into their right places. The canines therefore take important positions as guide-posts. May not this function explain the reason of what is nearly a universal law in comparative anatomy, that the lower canines fall in front of the upper; and also may it not have something to do with their late irruption? The teeth come up in such order as best enables them to adapt themselves to each other and their proper place.

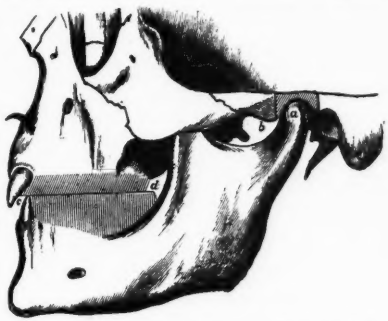

Fig. 5.—Side view of upper and lower jaws closed and at rest. *a*, condyle in glenoid cavity exposed by the removal of a portion of the bone at the root of the zygomatic arch. *b*, ridge in front of glenoid cavity. *c*, *d*, diagrammatic section of the plane in which the teeth meet when the jaws are at rest.

As before mentioned, a bird's-eye view of the lower jaw shows us that the back part of the condyles can be divided into parts of two circles (Fig. 8), a larger and inner, whose common centre (Fig. 8*a*) is outside the front teeth and a smaller outer, whose distinct centres (Fig. 8 *b*, *c*) are far behind the last of the back teeth.

When the jaw is drawn to the right, by the action of the external pterygoid muscle of the opposite side, it moves for a short distance, not more, I believe, that the width of half the grinding surface of a tooth in the large circle. On first noticing this action I was sanguine that the side teeth would prove to be arranged on the radii of this circle; and in three skulls which I have measured, it approximated so closely as to seem like confirmation.

Whilst there is only this slight lateral motion, of course both sides will move on radii of the same circle; but by increasing the action of the pterygoid muscle the left condyle will be brought forward under the zygomatic ridge (Fig 6 *a* and Fig. 9 *a*), and the right will turn on the circumference of the small circle. The combined motion of the circles will thus give the right side nearly a simple lateral action; whilst the left will be moved more downward and forward at the back of the mouth than in front (see Fig. 9 *e*, *e*, *e*, *e*); thus accounting for the fact that the inside of the upper and the outside of the lower are the highest cusps in those teeth (see Fig. 10), as whenever they are opposed to any extent, the condyle of that

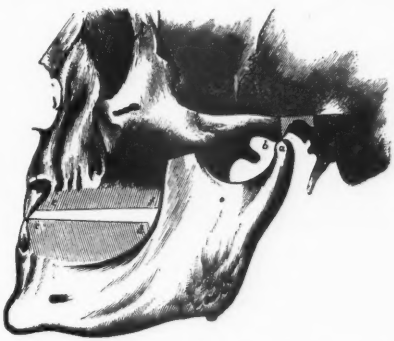

Fig. 6.—Same view of jaws as Figure 5, with lower jaw brought forward so that the edges of front teeth meet, showing that the condyle (*a*) coming under the ridge (*b*) increases the distance between the back teeth at *d* and *f*. *c*, *d*, plane of lower teeth. *e*, *f*, plane of upper back teeth.

side is depressed by being brought under the zygomatic ridge.

From the foregoing it is observed that Balkwill was the first to describe the downward movement and the lateral shift of the condyles, discovery of the former of which has been generally credited to Luce, Hays and Walker, while the latter was supposed to have been only recently (about 1912) discovered by Bennett.

The gothic arch is shown in Balkwill's Figure 9. He makes no mention of the gothic arch, as described by the incisor or other related points; but the fact remains that his illustration shows it.

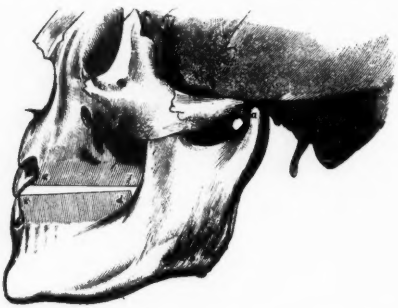

Fig. 7.—Ideal position of lower jaw, if in coming forward the condyle (*b*) had traversed a line parallel to *e, f,* instead of being depressed by the ridge, Figure 6, *b,* showing in this case how little would have been the space between *d* and *f*.

Balkwill mentioned an instrument in his article as follows:

> By means of this bite-frame, which has been shown to the Society before, the teeth can be placed in the right plane. The angle which the plane of the lower gums forms with the plane of straight lines drawn from the condyles to the front of the gums, is measured; also the distance of the front of the gums from the condyles.
>
> The lower model is then placed in the frame, in the same position relatively to the centre of the hinge; and the upper is fixed in the top saucer of the frame, according to the rectified bite previously taken.
>
> The lower back teeth are now mounted, and let down so as to make the angle of their plane, with that drawn to the condyles as before mentioned, as nearly twenty-six degrees as convenient.

From the foregoing, it is seen that Balkwill mounted the casts in certain relation to the hinge axis of his instrument and that he arranged the plane of the teeth with regard to the angle of the condyle path, which he approximated at 26 degrees.

Luce[8] followed in 1889 with investi-

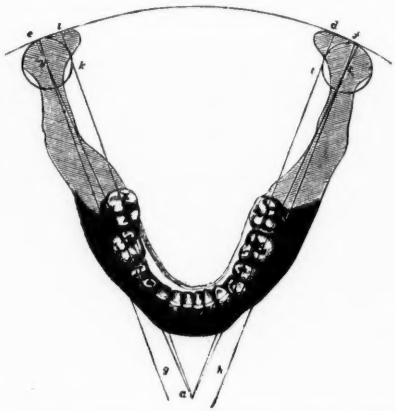

Fig. 8.—View of the lower teeth and diagrammatic section of the outline of the lower jaw, looking at it from above. *a,* center of circle, *e, i, d, f,* which forms the boundary of the condyles behind. *b, c,* centers of the two circles, *e k, l f,* parts of whose circumferences form the external angles of the condyles. The teeth when drawn to the left side, for instance, on that side, first move on the lines *a d, a c,* and then on *a c, c h,* and reciprocally on the opposite side.

gations that corroborated Balkwill's findings in regard to the downward movement of the condyles and disclosed

8. Luce, C. E.: Movements of the Lower Jaw, Boston M. & S. J., July, 1889.

further that the movements of the condyles were curved and that the condyle moved forward simultaneously with the opening of the mandible.

Luce's article is quoted verbatim:

This paper presents the results of certain original investigations conducted in the physiological laboratory of the Harvard Medical School under the direction of Prof. Henry P. Bowditch. The results obtained are interesting, as they indicate the exact movements of the jaw, and prove that certain errors exist in all descriptions of this articulation as given by the eminent anatomists and physiologists.

These discrepancies may be briefly noted as follows:

Fig. 9.—Facial part of skull viewed from below with outline of lower jaw left blank, *a c a'*, drawn to the right side by the left pterygoid muscle *b*. The white spaces, *e*, *e*, *e*, *e*, are the positions occupied by the tops of the lower teeth when at rest; the shaded spaces to the right of these show the lateral motion of the teeth from rest to the position supposed to be occupied by the jaw in the figure; the black spaces to the left show the reciprocal action when the other muscle alone acts. The shaded and black spaces on each side each blank space show the limit and direction of the lateral motion of the teeth. (The alternate teeth have been omitted to avoid confusion.)

Monro (Medical Essays, Edinburgh, 1735) wrote: "that the mouth could not be opened, if the lower jaw was protruded, without withdrawing it from its advanced position;" this is clearly incorrect, as will be indicated later.

Ferrein (Collection Academique, Paris, 1785) was quite accurate in his description, but he wrote that "the condyle advances under the eminence;" in many cases it goes under it and mounts the other side which he omitted to say.

Humphrey ("Human Skeleton," 1858) falls into the same error and says that "the condyle advances upon the glenoid ridge and should not go quite to the summit," which in many cases it certainly does.

Morris ("Anatomy of the Joints") was in error when he wrote that the condyle itself never reaches quite so far as the summit of the glenoid ridge.

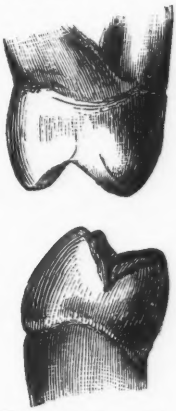

Fig. 10.—Depth of the sulci of the teeth on the balancing side analogous with the downward movement of the condyle.

Küss (Lectures in Physiology) wrote that the lower jaw, as it rises and falls, represents a lever moving around a supposed axis centred at the condyle, which remains in the glenoid cavity in small openings; and in greater separation the supposed axis is placed at, or near, the dental foramen; this is also incorrect, as will be proven later.

Quain ("Anatomy," 1883) states "that the condyle rests on the convex root of zygoma when the mouth is opened." As stated above, in most cases it advances farther forward than he states.

The error of Gray ("Anatomy," 1877) is in the statement that in openings of slight

extent, the condyles simply rotate on a transverse axis against the cartilages, whereas the condyles begin to move forward simultaneously with the beginning of opening. Again, he says the condyles simply "glide on to the articular eminence."

The first requisite in the study of jaw movements is to move the jaw and get a permanent record of the movement; the method used was the photographic, the same as that used by Marey and others, and may be described as follows: a bright silver bead was fastened to a wooden pin or dowel, which was firmly inserted between the lower central incisors; with the subject in a strong sunlight, so that a bright spot should be reflected from the bead, a pure profile or

Fig. 11.—The device applied to a skull.

side view was photographed, and the sensitive plate was exposed during the opening of the mouth; the bright spot reflected from the bead during the motion was continuously photographed and its excursion recorded on the negative as a line, giving the actual movement of the place upon the jaw to which the bead was opposed.

The earlier experiments dealt solely with the simple tracing at the symphysis, and while the results obtained with one bead were both instructive and interesting, the more valuable results were found by getting the relative movements of condyle, angle, and symphysis; to get tracings at these points, a light framework was constructed, which simply reached around the face from the lower incisor teeth, to which it was securely fastened, nearly to the ear; adjusting devices held bright beads which could be placed directly opposite the condyle, angle, and symphysis; the photographing took place as before, each bead making its tracing.

Figure 11 shows the device as applied to a skull; the pin is inserted between the lower front teeth, two of the bright beads being adjusted directly opposite the condyle and angle, the other in front of the symphysis. It is apparent that the jaw and device will move in concert, and that the movement of

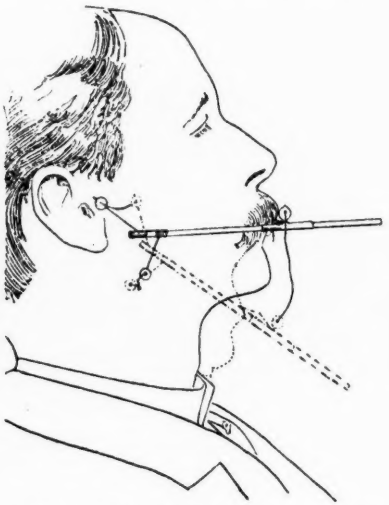

Fig. 12.—The tracings taken at the three points mentioned.

the beads is, in fact, the same as that of the points opposite to which they are placed.

Figure 12 represents the tracings taken at the three points mentioned.

It now becomes necessary to indicate the methods by which the several tracings were subsequently studied. The picture was enlarged in outline by optical projection, and the tracing of the opening at symphysis was subdivided into convenient spaces; then, by means of dividers, corresponding points in the tracings at condyle and angle were determined as follows.

Referring to Figure 13, it is evident that the distance between the point marked *O* in the tracing at symphysis and the point marked *O* at the condyle does not change, inasmuch as both points are attached to a device which does not change its length; and though these points may seek different positions when the mouth is opened, the distance between them remains the same; and we find the ends of the tracings at δ to be the same distance apart as at *O*, the beginning. If the dividers are set at the proper distance, we can find, by simple measurement, how far the condyle moves in a given movement at the symphysis, and the motion of the angle is worked out in the same manner. The numbers on the tracings in Figure 13 indicate the positions occupied simultaneously by the various points of the jaw, the movements of which have been studied.

Fig. 13.—Condyle begins to move forward immediately.

The tracings at all points in the jaw are readily understood, if we regard their motion as the result of a combination of a uniform downward and backward rotation round the condyle, with a forward motion of the condyle itself in a curved line, with the concavity upwards, always bearing in mind that this movement of the condyle is, at first, slow, then more rapid and subsequently slow again. It is evident that points in the immediate neighborhood of the condyle will have a movement differing very little from that of the condyle itself, while at more distant points the backward rotation round the condyle will be relatively more prominent, because the motion is on the circumference of a larger circle.

The tracings in Figure 13 illustrate this point. It will be noticed that the tracing nearer to that of the condyle is, like the latter, a curve with its concavity upward, but at the beginning and end of the motion, where the movement of the condyle is relatively slow, the rotation round the condyle

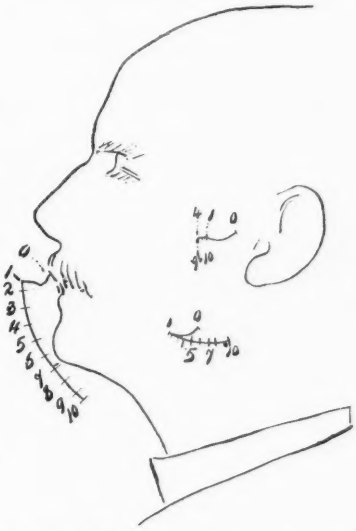

Fig. 14.—When the mouth was opened, the condyle continued to advance.

is able to impress its backward motion upon the tracing. In studying the motion of points in the ramus, successively more and more distant from the condyle, we observe that the backward rotation becomes more and more prominent as a factor, and the forward movement due to the gliding of the condyle round the articular eminence less and less marked. The fact that this forward movement is most rapid in the middle of its course explains the loop-like character of these

tracings, which is retained even so far down as the angle of the jaw.

By referring to Figure 13, it will be noticed that the condyle begins to move forward immediately, and even in a small opening of the mouth it performs quite a considerable excursion, contrary to the assertion of Gray and others to the effect that in small openings the condyles simply rotate on a transverse axis against the fibro-cartilages.

Again, it is stated by Morris Humphrey, and others that the condyle never quite reaches the summit of the eminence; most of the tracings show that it does reach the summit and even begins to mount the anterior side, as may be seen in Figure 13.

There are, however, exceptions, and it seems necessary that any assertion as to the action of this articulation should be qualified by the statement that there is considerable individual variation in the relative movements of condyle, angle, and symphysis.

The idea of Meyer (Die Statik und Mechanik des Menschlichen Knochengerüstes, Leipsic, 1873) that the jaw is suspended or hung in its lateral ligaments is substantially correct, and we can readily see that in moderate opening, when the condyle advances, the movement of the angle is comparatively slight, but when the capsular ligament becomes tense the condyle is kept from farther anterior movement and the angle goes back, as may be seen in Figure 13, the jaw swinging from the attachment of the lateral ligaments on the temporal bone.

Monro, as I have previously stated, said that if the jaw was protruded it would be impossible to open the mouth without the jaw sliding back, or a dislocation occurring, and Ferrein disputed this statement.

Fig. 15.—Tracings of a subject who tried to keep the condyle back while opening the mouth.

Fig. 16.—Tracings taken of the down and up motion of the jaw with the subject facing the camera.

Figure 14 vindicates the Frenchman, inasmuch as it shows that after protrusion, when the mouth was opened the condyle continued to advance, contrary to Monro's theory.

Figure 15 is a tracing of a subject who tried to keep the condyle back while opening the mouth, and it is shown, by comparison with the normal opening in Figure 13, that the condyle was held back in a measure, but the interesting point in this connection is that although Gray asserts that the condyle simply turns on a transverse axis in the

cartilage in small openings, this tracing proves that the condyle advances even if an effort is made to hold it back.

Other tracings were taken of the down and up motion of the jaw with the subject facing the camera. While the sensitive plate was being exposed the mouth was opened, the bead making its tracing, and when the mouth was opened widest the head was turned slightly, that the tracing of the bead in closing should not be in contact with the opening tracing. (Fig. 16.)

The lines drawn show that the jaw is not depressed or closed in a straight line; the tracings taken contain several curves, which will vary with the same person at different times, on account of the extreme mobility of this articulation and the fact that the condyles do not advance synchronously.

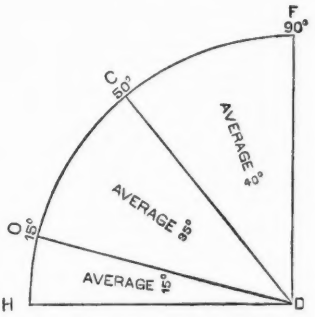

Fig. 17.—Relating the angle of the condyle path to the facial line.

These tracings are interesting to dentists, inasmuch as they show what has to be contended against in taking the "bite" preparatory to the insertion of an artificial denture.

To conclude, as Ferrein said one hundred and fifty years ago, the movements of the lower jaw are not well understood, and much that is written of them is at least faulty. Probably some inaccuracies may be explained by the fact that anatomists have made too much use of the cadaver to demonstrate the actions of the articulations, whereas it may be that the contraction of the various muscles cooperating with and antagonizing each other is the important factor in determining the exact movements of the jaw.

If these investigations throw any light upon the movements of the lower jaw, or awaken an interest in the further study of them, something will have been accomplished.

It is noted that the question of whether or not the condyle is the center of the opening movement in slight movement was a point of contention in Luce's time just as it is today. I believe, as Luce did, that it is not.

The first investigator and author to register individual relations (except centric relation) and movements of the mandible for study, in order to ascertain their character for the purpose of constructing articulator mechanism for imitating these movements was William E. Walker,[9] of Pass Christian, Miss.

Because of the fact that Walker's work was the first to take cognizance of individual movements of the mandible and was the beginning of and is the basis of the adjustable articulator then and now, and covered scientifically and so nearly completely the movements of the mandible and their registration and reproduction, I am going to quote extensively from Walker's articles so that those not familiar with his work may learn of it firsthand, and that those who are familiar with his work may review it.

Walker's findings brought about a new understanding of and an increased appreciation for individual mandibular relations and movements that remained unimproved on until Norman G. Bennett rediscovered, in about 1912, the mandibular lateral (Balkwill) movement, which has since been known as the Bennett movement.

The Walker method of registering

9. Walker, W. E.: Prosthetic Dentistry: The Glenoid Fossa: The Movements of the Mandible: The Cusps of the Teeth, Dent. Cosmos, 38:34 (Jan.) 1896; Movements of the Mandibular Condyles and Dental Articulation, ibid., 38:573 (July) 1896; The Facial Line and Angles in Prosthetic Dentistry, ibid., 39:789 (Oct.) 1897.

mandibular relations became known as the extra-oral (outside the mouth) method.

Quotations from Walker's papers follow:

In the lateral movement of the mandible, we are taught that the condyle on the side *toward* which the jaw is advancing remains stationary, except that it rotates on its axis. (The only exception to this statement that I have found is the following, from Holden's "Human Osteology," p. 88: "In masticating, we can readily feel that one condyle advances toward the anterior margin of its glenoid cavity, while the other recedes to the posterior." Bonwill says ". . . It stands still, or does not move backward; it merely revolves or rotates in the socket, which is but a trifle."—*Harris's "Principles and Practice," twelfth edition.*) This statement is not quite exact, as this condyle moves, though very slightly, both upward and backward.

We are also taught that the condyle on the opposite side—that is, the side from which the jaw is receding—comes forward. In reality it travels downward as well as forward on an incline; the course which the condyle travels being at an angle ranging from 25° to 45° to the line or plane of occlusion (I differentiate between the line or plane of occlusion and the line or plane of articulation, the former being a straight line tangent to the morsal surface of the inferior central incisors and the distal-buccal cusp of the inferor second molars, while the latter is a line tangent to the morsal surface of the superior central incisors and the distal-buccal cusp of the superior second molars) being from 30° to 50° to the facial line, while the average dento-occlusal facial angle being about 75°, gives an average of 15° for the angle formed by the dento-occlusal and the horizontal plane when the facial line is placed vertically.

Figures 17 and 18 will serve to make clearer what I mean.

F D represents the facial line, that is a line touching the most prominent points of the median line of the face (excepting the nose), the brow and the upper lip being normally the most prominent points. (The facial line here given is the only one we can use in our dealings with the living subject, as the facial line of the osteologist requires the exposure of the lower margin of the superior alveolar border, which is impracticable in practice. Therefore in measuring the naked skull we must allow for the thickness of the soft tissues, before comparing with the measurements of the living subject.)

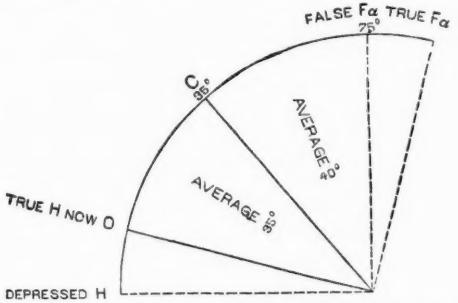

Fig. 18.—Relating the angle of the condyle path to the facial line.

In Figure 17, the facial line *F D* being vertical and *H D* perpendicular to it and therefore horizontal, the line *O D* will represent the average line of direction of the plane or line of occlusion (not articulation), and the line *C D* the line of direction traveled by the condyle; the average angles being HDO (15°) + ODC (35°) + CDF (40°) = HDF (90°), the right angle formed by the vertical facial line and the horizontal line.

When the mouth is opened the downward (as well as forward) excursion of the condyle causes the *ramus* to descend about three millimeters (or about one-eighth inch).

When the morsal surfaces of the incisors are brought in contact the drop at the condyle is about the same; for though the jaw is not opened so much, still the forward excursion of the mandible has caused the condyle to travel both *down* and forward.

In studying the movement of the condyle in the opening of the mouth there is found a point at the back of the ramus, about fifteen millimeters (five-eighths of an inch) below the upper surfaces of the condyle, which neither moves backward nor forward, but all of the mandible below this point falls backward in opening the mouth, and all above it, including the condyle, moves forward; the jaw does not swing directly from the upper surface of the condyle, but moves as though it were pivoted in a slot, with the imaginary pivot about fifteen millimeters below the upper surface.

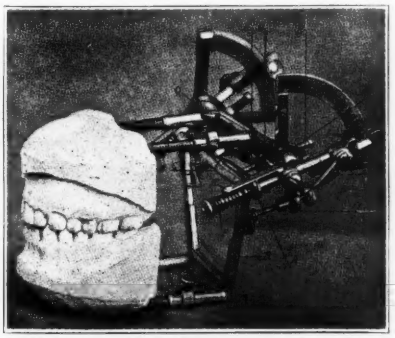

Fig. 19.—*E* is a bite-correcting fulcrum screw used to correct the bite when it is either too far forward, too far back, or falsely to one side or the other; *F* is another fulcrum screw which can be instantly removed with its supporting frame *G*, as it is only used in correcting a bite which is too close or not close enough; *H* is divided in its center so that the condylo-occlusal angle of one side may be adjusted independently of the other; *G* is an adjustable sliding collar which carries the bite-correcting fulcrum screw *F*, which passes through a slot in *E*, so that it is always parallel with the bar *H*, which controls the condyle-movement.

Variations from the averages given are due to the variable overlap and overbite of the incisors, and also to the slight difference in the incline of the roof of the glenoid fossa in different subjects.

The condylarthrodial (*Condylarthrosis*, "a form of diarthrosis wherein a condyle is set in a shallow and elliptic cavity, and free and varied movement of the joint is possible; condylar articulation." [*Gould's Dictionary, Medical, Biological and Allied Sciences, 1895*]) articulation in a socket having a forward and downward inclination of the roof gives the mandible a peculiar back-and-forward rocking motion during its antero-posterior excursion, while in swinging from one lateral position back to the center, and over to the other side, it causes the mandible to

Fig. 20.—Facial clinometer.

rock from side to side about four millimeters (about three-sixteenths of an inch), as though see-sawing on its antero-posterior axis.

These statements (which, however, I have not been able to find in the books) may be proved in two ways:

One is to place, *in a properly constructed articulator*, models of a normally articulated set of natural teeth, and move the lower jaw of the articulator so that the cusps of the teeth will take the various positions that they can be given in the mouth,—not only during

occlusion, but also in the "grinding" and in the "biting" articulation, when it will be found that *with an articulator permitting it* the part of the articulator representing the mandible will make the movements described above.

Another method is to select *a thin, accommodating subject,* without any superfluity of flesh on his jaws; the movements described can be plainly seen and felt, not only of the mandible as a whole, but of every portion,—especially the condyles and ramus,—which can be distinctly seen and felt to move as above described.

Elaborate studies have been made along this line,—as by Drs. I. B. Davenport, of Paris; Hans Block, of Dresden; W. G. A. Bonwill, of Philadelphia, and others; but nowhere do I find mention of this inclination of the roof of the glenoid fossa, and the consequent peculiar features of the movements of the mandible, as herein described.

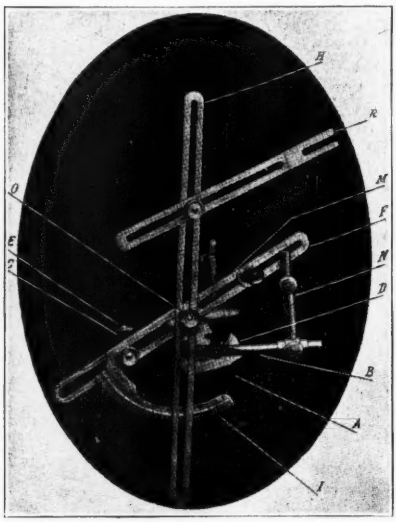

Fig. 21.—Facial clinometer without headpiece.

This movement of the condyles constitutes an important factor in many departments of our work in its bearings upon the articulation of the teeth, as in the study of the cusps of the natural teeth, with a view to bettering the articulation either in orthodontia or in the treatment of the disease commonly known as pyorrhea alveolaris; in the shaping of artificial cusps, whether in fillings, crown-work, bridge-work, or plate-work; in the treatment of diseases of the facial muscles, of plastic adhesions, and of the glenoid fossa, etc.

Dr. Bonwill's "Anatomical Articulator" has been quite generally accepted for many years as reproducing perfectly "all the movements of the human jaw." But in the use of this, as well as with other articulators, I so often met with failure in my attempts to give my patients something approaching normal facility in the "grinding" function *with artificial teeth* that I was led to study more carefully not only the articulation of the natural teeth, but also the movements of the jaw, and the

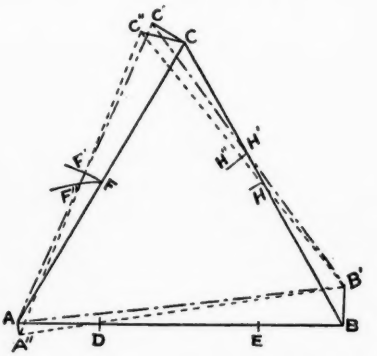

Fig. 22.—Diagrammatic illustration of the lateral movement of the mandible.

articulation of the condyle in the glenoid fossa.

Following Dr. Bonwill's instructions, and articulating the cusps of artificial teeth as he directs, I nevertheless found that, while the occlusion and articulation would be perfect *in the articulator,* it was not so when the plates were put in the mouth. For while the *occlusion* (I use the words *occlusion* and *articulation* as defined by Dr. Bonwill; see reprint from Harris's "Principles and Practice," 12th edition) would be similarly perfect in the mouth, the *articulation* was all wrong for "biting" and for "grinding"; the cusps would interfere,—some too long and others too short. I could not obtain in the mouth the normal points of contact, in the

forward and lateral positions of the jaw with artificial teeth articulated in Dr. Bonwill's anatomical articulator, according to his instructions. I then began to study the articulation of the cusps of the natural teeth, both in the mouth and from casts placed in the Bonwill articulator, and found that I could not obtain all the normal points of contact with the casts in the articulator as with the teeth in the mouth from which the casts were taken, the principal difficulty being that in the lateral movements the lingual cusps of the upper molars would rest upon the buccal cusps of the lower molars on the side *from* which the jaw was receding,

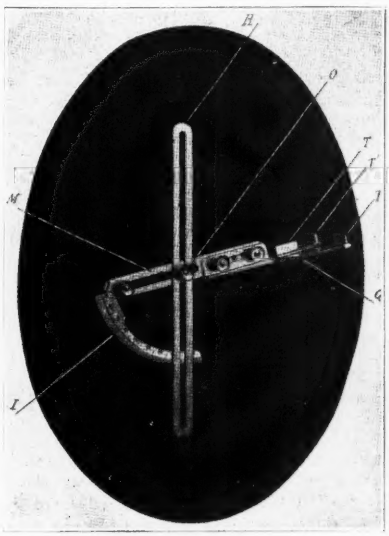

Fig. 23.—Part of the facial clinometer.

entirely preventing the teeth from touching on the side where mastication should be carried on, the space between the superior and inferior teeth on this side being three millimeters more or less. *Biting* was also prevented, the upper incisors being generally shorter than as represented by Dr. Bonwill, so that the upward turn of the posterior end of the interdental line—that is, the line of occlusion—would cause the second and third inferior molars to occlude with the first and second molars, holding the incisors entirely apart.

As you know, the angle in Dr. Bonwill's articulator which controls the representation of the movement of the condyle in the glenoid fossa forms a right angle to the portion representing the ramus, thus reproducing the *horizontally forward* movement of the condyle which we have been taught.

After much study and experimentation I found that to reproduce the correct articulation of the casts of natural teeth, in the various positions of the jaw, with all the normal points of contact of the cusps, it was necessary to increase this angle until, for the average jaw, it reached an increase of thirty-five degrees on a Bonwill articulator thus remodeled. (The articulator thus remodeled I christened the "Walker-Bonwill Articulator.")

Further experimenting showed that while this angle was adapted to reproduce a cor-

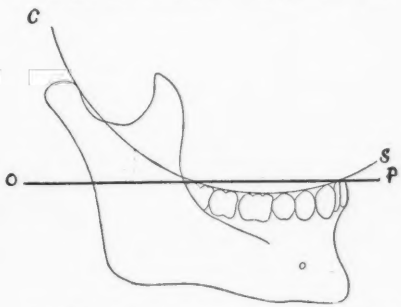

Fig. 24.—Curve of Spee (*C P*) and occlusal plane (*O C*).

rect articulation with casts of a large number of as nearly normal dentures as we generally meet with, still there were some cases in which the normal points of contact could not be obtained without either increasing or decreasing the angle.

I therefore had a Bonwill articulator remodeled with *an adjustable angle,* with a gauge to register the degree of the angle at which the teeth on the models of different jaws articulated as in the mouth. This articulator I have called a "physiological" articulator, because it is physiologically (that is functionally) as well as anatomically correct throughout.

Experimenting with a large number of models from natural teeth, I have thus far found the extremes as registered on the gauge

of my adjustable-angle articulator ("Walker's Physiological Articulator") to reach as high as 45 degrees in one case and as low as 22½ degrees in another (a case of extreme irregularity and therefore abnormal), 35 degrees representing the average angle of the slant of the roof of the glenoid fossa, as shown by the course traversed by the condyle. (See Figs. 17 and 18.)[10]

My desire for information on these points[10] led me to enlist the services of men who have access to libraries such as are not within my reach.

The manuscript of my paper[10] having been placed in the hands of Dr. E. C. Kirk, as editor of the *Dental Cosmos,* with the request that he would kindly refer me to anything within his knowledge bearing upon these points, he some weeks later directed my attention to an article published in the ***Boston Medical and Surgical Journal,*** July 4, 1889,—viz., the report, by Dr. Charles E. Luce, of the Harvard Dental School, of certain original investigations in the movements of the lower jaw, conducted in the physiological laboratory of the Harvard Medical School, under the direction of Professor Henry P. Bowditch.

Fig. 25.—Spherical curves or surfaces ground from plaster blocks with the movements of the articulator.

It was very gratifying to me to learn that these distinguished investigators, working by widely different methods from my own, had reached the conclusion to which I had been forced,—viz., that "certain errors exist in all descriptions of this articulation given by the eminent anatomists and physiologists."

The published report of the Harvard investigations antedates my own studies by several years, but their work was quite unknown to me until pointed out by Dr. Kirk, and does not appear to have attracted the attention of the dental world, with the following single exception, as far as I have been able to learn.

In the words of Dr. Luce, "the first requisite in the study of jaw movements is to move the jaw," and the second "to get a permanent record of the movements."

In the Harvard School investigation, the photographic method of recording the movement of the jaw was employed. A light framework was constructed, reaching around the face from the lower incisors (to which it was securely fastened) nearly to the ear. By adjustable devices bright beads were placed directly opposite the condyle, gonion and symphysis. The subject being placed in strong sunlight, a profile view was photographed, the bright spot reflected from the bead during the motion of the jaw, in opening and closing the mouth, being continually photographed, and recorded on the negative as a line, giving the actual movement of the place upon the jaw to which the bead was opposed.

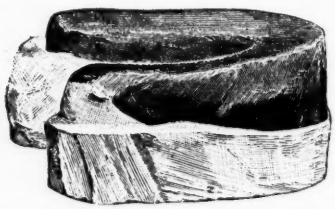

Fig. 26.—Spherical curves ground from rubber occlusion rims by the living subject.

As recorded by this device, the mouth being opened to its greatest extent, the movement of the condyle is traced "as a curved line with the concavity upward," the beginning of which, or that portion traced in the "short openings" of the movements of mastication, being, as I was gratified to see, in the "forward and downward" direction that I had observed, and, as shown by a study of the illustrations, at about the same incline to the

10. Footnote 9, first reference.

facial line that I had noted as the average in normal articulation.

The illustrations, it is to be presumed, are given as a correct reproduction of the photographs, with the relative proportion observed between the width of the face and the extent of mouth opening. Assuming this to be the case, the subjects opened the mouth much wider than I have been able to obtain. I have measured the mouth opening compared with the width of the head sighted from the front, and find in my practice that the mouth opening in less than one-third of the width of the head, while in the illustration showing a front view it is more than one-half as great.

These tracings are spoken of by Dr. Luce as being "interesting to dentists, inasmuch as they show what has to be contended against in taking the bite preparatory to the insertion of an artificial substitute." But, to my mind, a far greater interest attaches to the

Fig. 27.—Spherical curves ground from rubber occlusion rims by the living subject.

correlation of the line traced by the condyle in the movements of the mandible, and the facial line.

After the reception of the report of Dr. Luce, in order to more thoroughly study the subject, and to confirm the results of these different methods of observation, I constructed an apparatus somewhat similar to the one used in the Harvard Laboratory, and obtained the photographs which I present for your inspection. They are from the untouched negatives, the white spots showing the location of "beads," and the lines made by this change of position in the movements of the mandible."

To further verify these observations in another series of experiments, I replaced the "bright beads" by a small point of pencil-lead, which traced the movement of the condyle on a sheet of stiff paper held against the side of the face, with the edge parallel with the facial line.

By this method the movements in a large number of cases can be traced in the time required to photograph and develop the negative of a single case.

In edentulous cases I fastened the appliance to the handle of an "impression-tray," in which I used Teague's impression compound, additionally securing it by clamping to the mandible when necessary.

By this method I obtained tracings from a large number of individuals, but failed in a single instance to obtain so great a curve, or, proportionately to the size of the illustration, so long a line as shown in the Luce report. I should say, however, that his curve was apparently derived from the movement of the condyle when the mouth was opened to a very extreme degree.

There is a certain definite co-relation between the morphology of the morsal surfaces of the teeth, and the angles made by the intersection of the functional portion of the condyle path (by which I mean that short straight portion of the condyle, tracing forward and downward, made in the movements of mastication extended till it intersects the facial line) with the facial line, which I call the condylo-facial angle; also the angle made by the intersection of the condyle-path with the plane of occlusion or the alveolar angle, as the case may be.

In the paper before referred to,[10] I gave the conclusions which I had deduced from my experiments in the articulation of the models of natural teeth, and the great variations found in the condylo-occlusal angle of different subjects, ranging, as I there stated, from twenty-two and one-half degrees in one case to forty-five degrees in another, those being the greatest extremes noted up to that time. More extended observation, however, has shown an even greater range. Having proven to my own satisfaction the fact of this variation in the condylo-occlusal or condylo-alveolar angle, I constructed an articulator with an adjustable angle to reproduce these variations with degree gauges to record the measurement of the angle, which varies not only in different subjects, but also very considerably in the movement of the two condyles of many individuals. I have also constructed an apparatus which I have called a facial clinometer. This device registers the direction of the condyle path and of the plane of

occlusion (or the alveolar plane in edentulous subjects), as compared with the facial line, and measures in degrees the angles formed by the intersection of these lines; also the "classic facial angle," the mandibula-facial angle, etc. It also measures in millimeters the distance that one condyle moves forward with the synchronous backward movement of the other condyle in the function of mastication.

I quote from Holder's Human Osteology: "In masticating we can readily feel that one condyle advances toward the anterior margin of the glenoid cavity, while the other recedes to the posterior." The authorities are not in accord on this point, but the clinometer shows it very plainly. It is true that in some subjects the condyle does not move back at all, while in others it recedes considerably, and often one condyle recedes more than the other."

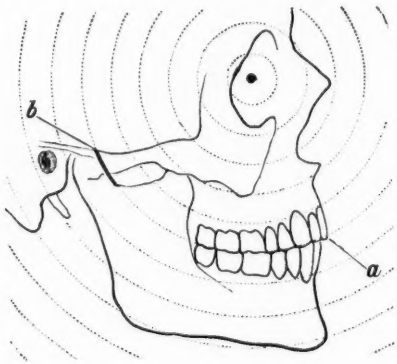

Fig. 28.—Condyle path with inclination of about 45 degrees to the horizontal plane.

The angles and measurements thus recorded by the facial clinometer not only fully confirm the deductions from my experiments with models of the natural teeth, but show an even greater range of variation in the angles in question, not only between different individuals, but in the movements of the two condyles of the same person.

It has been said, "In the domain of organic life there is rarely perfect symmetrical correspondence in the two halves." This last condition was therefore anticipated, but not to the remarkable extent demonstrated by actual measurement.

I will cite two most remarkable illustrations of this great variation.

One a gentleman of sixty years, for whom I made a full upper and lower set. He had never worn plates before. The clinometer recorded the condylo-alveolar angle as one degree on one side and ten degrees on the other, with which angles in the articulator a reciprocating articulation was obtained. This case has the lowest angle I have ever encountered, but it is largely due to the fact that his molars were lost some years ago, while a pair of bicuspids and the incisors were only removed a few months ago. Thus the alveolar process is greatly absorbed at the rear, but scarcely any at the anterior portion. When absorption takes place in front, the angles will undoubtedly become greater.

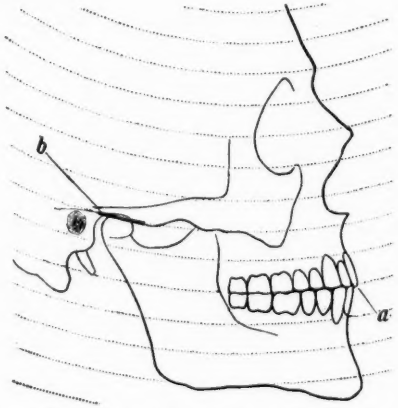

Fig. 29.—Condyle path with practically no downward inclination.

The second case is that of a lady seventy years of age. She has natural teeth below, but has worn an artificial set above for over twenty years, having had different sets made in New York and elsewhere, but never with satisfaction, not having been able to bite.

The condylo-alveolar angle in this case was twenty-two degrees on one side and forty-four degrees on the other. The variation was so great that I doubted the correctness of the record, and concluded that I had failed to get the indicator exactly over the condyle. Not wishing to trouble the patient with a repetition of the measurements, I,

in placing the case in the articulator, made a compromise, taking five degrees from one side and adding five degrees to the other side. But I found it impossible to get a reciprocating articulation until I had restored the angles to the clinometer record. This was a peculiarly difficult case, not only because of the extreme angles, but because the lower molars were worn by contact with the porcelain teeth above, and the lower incisors having been relieved of all work were very long, and the patient unwilling to have them shortened.

The articulators devised by Drs. W. G. A. Bonwill, E. T. Starr, W. W. Westmoreland, and more recently by R. H. Antes, have, it is true, both a lateral and a protrusive movement, but inasmuch as they fail to reproduce the drop of the ramus due to this hitherto unrecognized combined forward and downward movement of the condyle, they do not reproduce the true movement of the mandible, and therefore do not permit the normal articulation of the cusps of models of the natural teeth. Consequently they cannot be relied upon to produce a correct articulation of artificial substitutes.

The physiological articulator, with its adjustable angle, its degree and millimeter gauges for recording the measurements taken by its adjunct, the facial clinometer, will probably appear too complex to some, especially as compared with the dental articulators heretofore in use, which, with few exceptions, have been mere occluders. But to those who desire to give their patients the best results possible, and who are not satisfied with anything short of scientific accuracy, the study of the mandibular movements as measured and recorded by the clinometer, and reproduced by the adjustable articulator, will be found not only instructive and interesting, but also of great practical value in their applications.[11]

An articulator, to be reliable as a guide to the correct articulation of artificial teeth, must be capable of reproducing the articulation of casts of natural dentures, in all the different positions in which the lower jaw can be placed for grinding food, biting, etc., as well as in simple occlusion; otherwise we could reproduce only the simple up and down movements of opening and closing the jaws, without the possibility of lateral movement except with teeth nearly or quite devoid of cusps. Figure 19 shows the Walker physiological articulator, designed to fulfill the indications noted. *A* represents the mandibular condyle and is, in construction, a ring attached to the ramus *B* through the bar *C* and slides on the bar *D*, which controls the movement of *A*, and thus represents the condyle path. *E E* is a bite-correcting fulcrum-screw, against which the bar *C* rests, being pressed against it through the action of the spring *F* on *A*. The distance that *A* is moved by *E* is shown on the millimeter gauge *K*. *G*

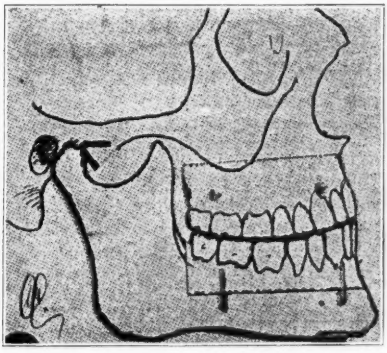

Fig. 30.—Dentures with a curved bite-path in resting position.

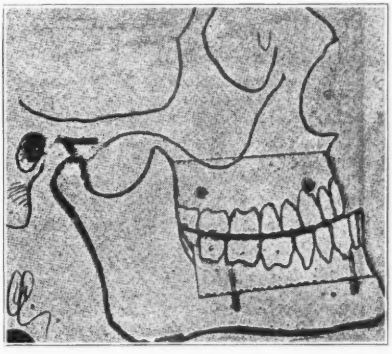

Fig. 31.—Dentures in Figure 30 in forward bite position with the jaw carried along the steep joint-path.

11. Footnote 9, second reference.

is another adjustable fulcrum-screw which plays against the back of the ramus *B*, and is easily removed with its supporting frame *H*, being required only in correcting a bite which is too open or too close. It causes the condyle to move forward and downward when the jaws are separated, which is of no moment in the construction of a denture unless the bite has to be changed. The bar *N* is divided at the median line, so that the condylo-occlusal angle of each side may be adjusted independently, as they often vary. An adjustable sliding-collar *O* carries the bite-correcting fulcrum-screw *E*, which passes through a slot in *N*. The bows *P* and *L* carrying the casts are secured by set screws *Q* and *R*, and are in all cases to be pressed in as far as possible, and should never be moved to correct the occlusion. *I* is a clamping screw which binds *D* to the degree-gauge *J*, *D* being adjusted at the condylo-occlusal angle of the patient (or the condylo-alveolar angle in an edentulous case), the angle having been ascertained by the use of the facial clinometer as will be described later in this paper, and demonstrated in the clinics. The figure on the degree-gauge *J*, where it is crossed by the bar *D*, represents the angle formed by *D* and *L* when projected to the point of intersection. The casts are to be so mounted on the loops that the plane of occlusion (alveolar plane) shall be parallel with *P* and *M*.

In the short movements of mastication, the condyle on the side toward which the jaw is advancing travels forward and downward, on a line which being extended till it intersects the facial line forms at the point of intersection an angle which varies with and bears a definite relation to the morphology of the morsal surfaces of the teeth.

As this angle varies very considerably, not only in different individuals but also very frequently in the two condyles of the individual, it is desirable and important—*first*, to be able to determine accurately the direction of the movement of the condyle,—the condyle path as I have termed it—compared with the facial line and the plane of occlusion in the functioning of the mandible, and —*second*, to be able to exactly reproduce the movements of the jaw in an articulator carrying the substitutes for lost dentures.

The path traversed by the condyle, extended till it intersects the facial line, forms at the intersection of these lines what I have termed the condylo-facial angle. The difference between this angle and that formed by the alveolar plane and the facial line, is the condylo-alveolar angle, to which I set the adjustable angle of my physiological articulator, in order to reproduce the exact movements of the jaw of the subject whose measurements have been taken.

The importance of the study of these facial lines and angles is pointed out by Dr. Broomell in the article before referred to with special reference to ascertaining the tooth-line level.

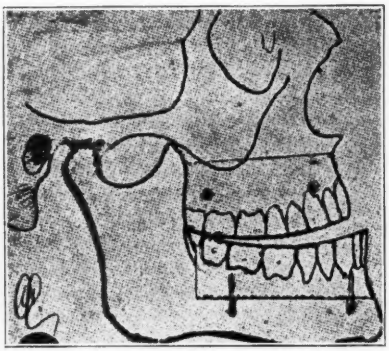

Fig. 32.—Dentures in Figure 30 in forward bite position with the jaw carried along the horizontal joint path.

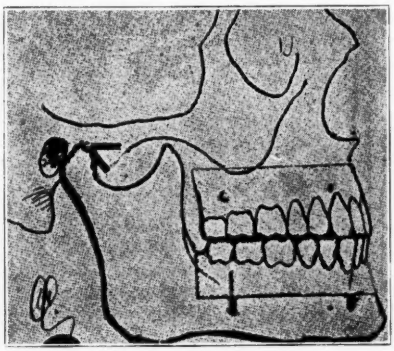

Fig. 33.—Dentures used in Figures 30, 31, and 32 substituted by a set with a straight bite-path in resting bite position.

To measure the condyle-movement and these various lines and angles, I have devised an instrument which I have called the facial clinometer (Fig. 20). This appliance (which I will demonstrate in the clinic room) is made in two separate pieces and a number of small adjuncts. The adjustable jaw-piece *B* (Fig. 21), which is made of aluminum, is to be secured to the lower jaw and moves with it. When the lower anterior teeth are present, the piece is secured to these teeth. In edentulous cases, a lower impression is taken and a base-plate made (by the method of Dr. T. C. West, of Natchez, Miss.), as follows: Having obtained an accurate cast showing the seat of the lower artificial denture, coat the cast with rubber cement, and press in with the fingers only a sheet of black vulcanizable rubber, which will adhere to the cast because of the cement. Vulcanize, but only about three-fourths of the time required for a finished piece. This base-plate (Fig. 21 *A*) is trimmed to accommodate the muscles, and then secured to a lower impression tray (*C*) by means of plaster of Paris (*D*). When the plaster has hardened the jaw-piece of the clinometer is secured to the handle of the impression tray by the set-screw *E*, and the base-plate placed in the mouth, serving as a support to the jaw-piece of the clinometer. The condyle of the patient is located by pressing with the ball of the thumb in front of the ear of the patient, during movements of the jaw in slowly opening and closing the mouth, its position when at rest being indicated upon the skin with a slight ink or pencil mark, or a bit of court plaster may be used if preferred. In a very thin person the movement of the condyle may sometimes be seen quite distinctly.

A projection at the upper end of the adjustable upright *N* (Fig. 21) of the jaw-piece is placed exactly over the condyle as located. The head-piece (Fig. 20) being also in position the projection of *N* (Fig. 21) plays in the slot of the transverse-bar *M* (Figs. 20 and 21), which is loosely pivoted to the upright *H* at *O*, the direction of *M*, which moves freely on the pivot-screw *O*, being determined by the movements of the jaw to which *N* as part of *B* (Fig. 21) is secured. When by repeated opening and closing (the projection from *N* sliding easily in the slot of *M* without changing its position as the mouth is opened and closed), the set-screw *O* is tightened, the angle made by the condyle path (represented by *M*) with the facial line (represented by *H*) being registered on the degree-gauge *I* in the slot of the upright *H*. This is the condylo-facial angle. The millimeter gauges serve to measure simultaneously the distance traversed by the condyles in the excursions of the mandible, one moving forward, the other usually receding a little, sometimes not perceptibly, but in some cases a distance one-third that advanced by the other. I quote from my second paper:[11]

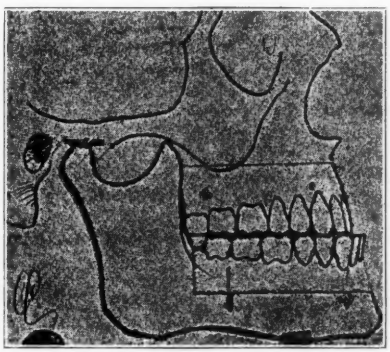

Fig. 34.—Dentures in Figure 33 in forward bite position with the jaw carried forward along the horizontal joint path.

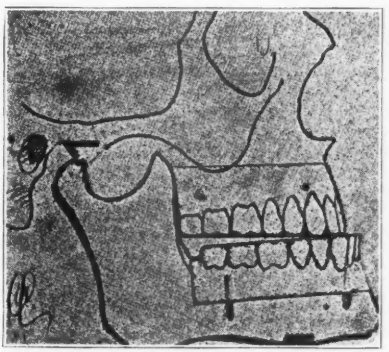

Fig. 35.—Dentures in Figure 33 in forward bite position carried forward along the steep joint-path.

"The ratio between the forward movement of one condyle and the synchronous backward movement of the other varies greatly in different individuals, and even in the same individual the ratio often varies in the left lateral movement as compared with the right. This distance measurement is registered in millimeters by the clinometer, and recorded on the articulator, where it serves to correspondingly regulate the distance at which to place the bite correcting fulcrum-screws from the condyles of the articulator. The importance of being able to recognize the extent to which, in any given case, one condyle recedes as the other advances, and of being enabled to utilize the observation, is illustrated by the diagram Figure 22.

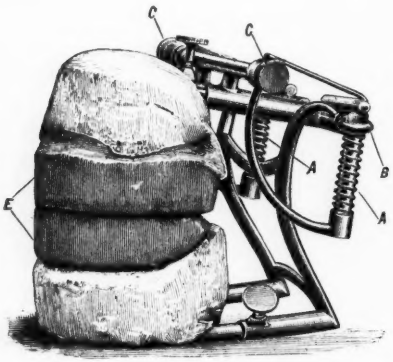

Fig. 36.—Christensen articulator with casts in resting bite.

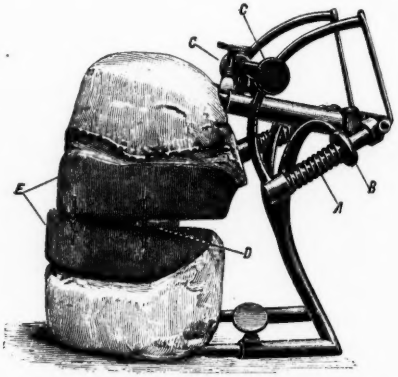

Fig. 37.—Christensen articulator with casts in forward bite position registering the steep of the condyle paths.

The mandible, as we know, is based on the equilateral triangle, the sides measuring four inches. In the diagram, *A* and *B* represent the condyles, *C* the point between the central incisors. If we imagine that the mandible is thrown to the left, and that the *left condyle A does not recede, B,* the condyle on the left side, takes the position *B'*, while *C*, the median line of the incisors, travels to *C'*. In the molar region *F* travels to *F'* on the left, and *H* to *H'* on the right. But in a case in which the right condyle *B* advances the same distance as before, while the left condyle *A* recedes one-third of that distance, moving to *A"*, we will find that the entire triangle acts as though turning on the fulcrum *D*. C, instead of moving to *C'*, will reach *C"*, while *F* will have moved to *F"*, and *H* to *H"*.

In constructing a set of teeth for a subject in whom, by reason of the condyle receding on the guiding side, the fulcrum is at *D* as shown, instead of at *A*, if by reason of the construction of the articulator the fulcrum is immovably fixed at *A*, instead of being movable to suit the case, we should find the articulation at fault to the extent of the difference between the points *F'* and *F"*, *H'* and *H"*, *C'* and *C"*, respectively, causing inevitable interference of the cusps, necessitating either the sacrifice of the cusps or the reconstruction of the set.

By comparing Figures 20 and 21, it will be recognized that *H, O, I, M,* and *R* are in both figures, *H* and *M* of Figure 20 being enlarged in Figure 21, and showing the relation between the jaw-piece and the head-piece. *H* is supported by the adjustable head-band *L* (Fig. 20) which surrounds the head and rests upon it as seen at *P*. *H* having been adjusted parallel with the facial line is held rigidly by the set-screws of the bracebar *R*. To adjust *H* parallel with the facial line, projections from the center of the cross-bars *A* and *B* (Fig. 20) are placed respectively against the upper lip close under the nose, and the brow between the eyebrows, the bars being thus transversely at right angles to the facial line. The upright *H* is placed in contact with the ends of *A*

and *B*, so that it in turn becomes parallel with the facial line, which it serves to represent, the angle made by the transverse-bar *M*, in the position to which it is guided by the movements of the jaw through the upright *N* of the jaw-piece (Fig. 21) being found recorded on the degree-gauge in the slot *H* as before described. Having thus found the condylo-facial angle the jaw-piece is removed and the piece *Q* (Fig. 23) is secured to *M* (Figs. 20, 21 and 23), and placed in the mouth with the parts *T*, *T'*, *T''* touching the upper alveolar process. *M* playing on the pivot-screw *O* in the upright *H* (Figs. 20, 21 and 23), *H* being parallel with the facial line as before, in the center of the slot in *H* on the degree-gauge *I* will be found registered the alveolo-facial angle.The mathematical difference between the alveolo-facial

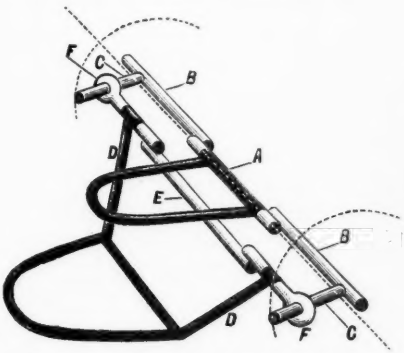

Fig. 38.—Christensen schematic model articulator.

angle and the condylo-occlusal angle, to which angle the degree-gauge *J* of this articulator (Fig. 19) is set, for each individual case, in order that the mandible or lower jaw of the articulator may functionate in exact reproduction of the movement of the mandible of the subject. The degree-gauges of the clinometer, by means of various appliances which will be shown in the clinic, register not only the angles of which I have spoken, but others, such as the mandibulo-facial, the classic-facial, the articulo-facial, the alveolo-facial, the occluso-facial, the dento-facial, and other angles, all of which are of scientific interest and all of value to the dental and oral prosthetist who desires to secure that scientific accuracy essential to perfection in the practical value of, and comfort to the wearer of, dental prosthetic appliances, and which have a more or less direct bearing upon the perfection of the results to be obtained through the use of the physiological articulator and the facial clinometer.[12]

The only progress and improvement made in the subject since Walker's time is individual measurement of and guidance for the positions and movements of the mandible in three dimensions (movements of the condyle on the working side

Fig. 39.—Recording instrument in position.

and of the incisor point), the first of which was done by Monson and Stansbery with wax and plaster check-bites and the latter by Lentz and Hall, reported in my paper "Full Denture Construction."[13] While it is true that a great amount of work has been done in the subject since Walker's time, it is

12. Footnote 9, third reference.

13. Hall, R. E.: J. A. D. A., 16:1157 (July) 1929.

also true that the progress noted is all that counted for anything in the end, other, of course, than elaboration on certain points and improvement of our information on the subject in general, in which case it has all been of inestimable value.

Christensen[14] was the next investigator and author to evolve means different from Walker's for registering individual mandibular relations for study of the movements of the mandible.

The Christensen method for registering positional relations of the mandible differed from Walker's in that it was registration secured inside the mouth and was limited to use in securing the protrusive relation of the mandible only;

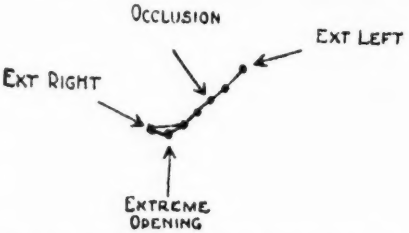

Fig. 40.—Left condyle. Path nearly straight.

whereas, the Walker method included registration of both the protrusive and the lateral relations.

The Christensen method of registering mandibular relations became known as the intra-oral (inside the mouth) method.

Walker and Christensen were the first to make observations on and studies of individual jaw relations and movements, outside, of course, of the one who first registered centric relation (bite).

14. Christensen, Carl: A Rational Articulator, Ash's Quarterly Circular, 1901; The Problem of the Bite, Dent. Cosmos, 47:1184 (Oct.) 1905.

Preceding Christensen's exposition of his method for registering the protrusive relation of the mandible, he sets up an hypothesis for the movements of the mandible corroborated by confirmatory experiments purporting to prove the correctness of his hypotheses. These experiments led Christensen on to where he conceived of and employed the means for registering mandibular relations (protrusive relation) since known as the Christensen intra-oral method.

Christensen's registration method, while not so nearly complete as Walker's, was, nevertheless, more practical, and therefore was accepted and put into general use, serving as the basis for the intra-oral method of registering positional

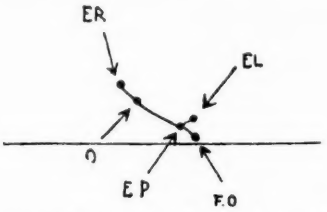

Fig. 41.—Right condyle. Path nearly straight.

relations of the mandible so popular (popularized by Monson) in the recent past.

Because of the very interesting work done by Christensen and the important part it has since played in the subject, I am going to quote extensively from Christensen's articles. Christensen, as the quotations will show, is the investigator that gave us the spherical theory hypothesis of mandibular movements since elaborated on by Monson and Wadsworth.

Before quoting Christensen on his exposition of his hypotheses, I wish to precede this part of his article by quoting what he and Gysi have to say about the

work of F. Graf v. Spee,[15] in regard to Spee's curve (curve of Spee). Spee's work is here in line for discussion, which I will pass with the quotations from Gysi and Christensen, they having presented and commented on Spee's contribution and ideas in this particular most comprehensively. Please observe closely the points brought out in the quotations from Gysi and Christensen. They are very important considerations in the study of the movements of the mandible and development of the articulator.

Gysi states:

The anatomist Graf v. Spee was the first to show that this curve (curve of Spee), Figure 24, had a certain relationship to the

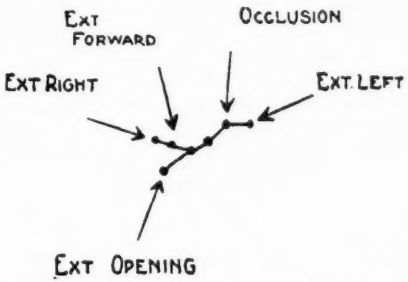

Fig. 42.—Left condyle. Path sigmoid.

slant of the eminentia articularis as well as to the condyle path, and that the forward movement of the mandible followed the arc of a circle (Spee's curve), the center of which could lie between the orbital cavities or above them in the median line of the face. "In the forward bite the condyles and teeth describe the same circular movement. . . . The steeper the path of the condyles the more pronounced the tooth curve will be, because both have the same radius." (Spee.)

See also Frank's findings and comments on Spee's curve (Footnote 23).

15. Footnote 14. Gysi, Alfred: Problem of Articulation, Dent. Cosmos, 52:148 (Feb.) 1910.

Morton,[16] in discussing Spee's curve, stated:

Regarding the sagittal occlusion curve of Spee, Dr. Frank mentions that each mouth he has examined has a different length of radii. This is quite normal, in that the curve is in direct relation in normal mouths to the distance measuring from the condyle to the symphysis, and the angle between the body and ramus of the mandible in each individual mouth examined; so too, if he examines the radii of the sagittal occlusion curve of an artificial denture in which the models were placed anatomically correct in the articulator, and with perfect articulation, he would still find this difference in the sagittal occlusion curve, for, as I have stated before, it corresponds to the distance between the condyles and the symphysis and the angle between the body and ramus of the mandible.

Christensen,[17] states:

F. Graf v. Spee, in his work on the displacement path of the jaw ("Die Verschiebungsbahn des Unterkiefers am Schadel," Arch. f. Anat. u. d. Physiol., 1890), has succeeded in forming a clear view of the movement in a single instance, and has thereby pointed out the correct means of understanding the principle of the movement.

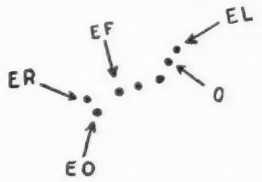

Fig. 43.—Left condyle. Path irregular.

Other writers have taken but little notice of Spee's work, and the few who have noticed him have underestimated its importance, which probably is caused by his being chargeable with a few obvious errors.

Spee ought to be credited with pointing out the important and at the same time very simple truth, that the path of the condyle during the bite movement must be in conformity with the bite-path. . . .

16. Morton, J.: Articulators; A Criticism of Dr. Frank's Investigations and Experiments, Brit. Dent. J., 29:909 (Oct.) 1908.

17. Footnote 14, second reference.

His study of the profile of the cranium led him on to the view that the lower jaw during forward and backward displacement is swinging as a pendulum on an axis which must be imagined to go through a point in the orbit somewhat back of the lacrymal crest, and that the biting surfaces of the teeth and the front part of the condyle therefore will describe paths which very nearly follow the very same cylindrical surface. ("Sich auf demselben Cylindermantel bewegt haben.")

This observation, however, relates only to a cranium with a pronounced "upward" concave bite-path, and from this alone it may be seen that the observation does not hold good in all cases; but this does not diminish the value of Spee's work, for it is his *mode* of observation which gives the research its great worth.

Spee's views of the nature of the jaw-joint during movement is more of a mechanical than an anatomical character, and he himself points out that there seems to be a discrepancy between his hypotheses and the accepted conception of anatomical conditions; thus, opposing Langer's opinion regarding the form of the condylar path during bite movement, and from a mechanical point of view, he here presents his special conception of the co-operation of the meniscus for removing the discrepancy.

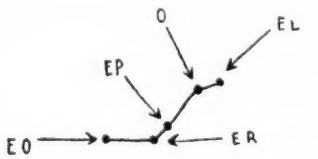

Fig. 44.—Left condyle. Path sigmoid.

The above must be sufficient for indicating how Spee has opened the way for a simple and practically suitable consideration of the nature of the movement, which path I have subsequently pursued still farther, and have thereby been led to a somewhat different conception of the nature of the movement in question.

THE WRITER'S HYPOTHESIS

In presenting my hypothesis, I beg to remark that I deem it unnecessary to present any suppositions in order to bring harmony between the prevailing views of the mechanical nature of the temporo-maxillary articulation and my theory of the path of the bite movement. It is my opinion that the proof of the correctness of the hypothesis can only be reliably demonstrated by observation of the movement-phenomenon itself as it presents itself during the motion of the rows of teeth against each other; for it must be remembered that the minute details of the articulation's anatomico-mechanical nature—which are to be considered here in the living individual—are still a closed book to us, and for this reason are hardly suitable as the real basis for our line of argument.

It is, consequently, the paths of the jaw during the bite movement which we propose to determine; it must, however, be remembered that we here always speak of the matter in connection with artificial complete dentures; and it will therefore not be the accidental, more or less normal bite-path in a mouth with natural teeth, but on the contrary the movement-path corresponding to the individually ideal bite-path in a toothless mouth which we are to find, i.e., the path the main features of which we are to follow in the construction of a denture.

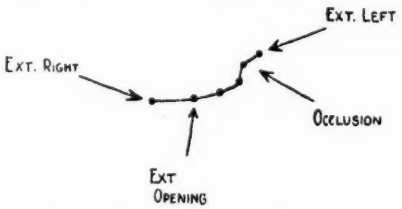

Fig. 45.—Left condyle. Path sigmoid.

We must first examine more closely the relation between the bite-path and the bite movement, and we shall then see how such an imagined ideal bite-path in a toothless mouth must necessarily be formed and situated—if we consider the matter from a mechanical point of view without regarding our merely conjectural knowledge of the details of the peculiar mechanism of the condylar articulation.

We know for certain only the main features of its forms of movement, but we do know that the displacement of the jaw consists essentially only in the forward and backward displacement, or, if only one condyle

be carried forward, of a corresponding revolving of the other condyle *almost* on the spot; actual side-displacement, however, we may consider as excluded.

If now, with these forms of movement in view, we in a merely abstract way consider the jaw's bite and joint mechanism as a whole as it really is, in a mechanical sense—two separate and rigid parts, an upper part and a lower part, that touch each other at three places separated from each other, corresponding to the bite-path and the two joints—then we have a simple schematic view which as a general formula may serve us in explaining the matter.

In the bite-path the contact takes place under the form of surfaces, but in each of the two joints it must be considered as the touch of a point, the condyle (the lower part's) against a surface (the upper part's joint-surface).

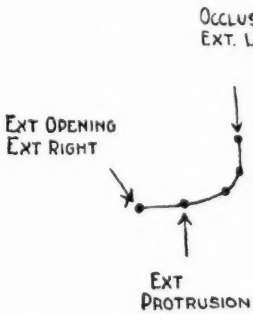

Fig. 46.—Left condyle. Path markedly convex downward.

If now, as we will suppose, the ideal bite-path in this view is of such a form that contact between the bite-surfaces is completely maintained during displacement, then the form of this path must be one of the two; either *plane* or *spherical*. (As a plane in a mathematical sense may be considered a special case of a spherical surface, i. e., a spherical surface with an infinite radius, we can, for the sake of convenience use only the term spherical.)

Spherical surfaces are, namely, the only form of surfaces which will admit of any displacement of these against each other in the direction of movement indicated by our figure, unless the contact between the surfaces be partly discontinued.

The bite-path in our imagined view does really form what Henke calls "a joint-connection with grinding (*schleifende*) contact-surfaces," and the fundamental principle for constructing these surfaces is expressed as follows: "They must be capable of moving without describing anything but their own ideal continuation."

On this theoretical supposition I base my opinion that the path for the jaw's bite movement—therefore also the ideal bite-path—must always follow spherical surfaces, if it be possible to obtain the necessary extensive contact at all; but it must be remembered that these spherical surfaces have an individually different curve, ranging from an almost plane surface with an infinite radius to the much curved surface with a radius of a few inches.

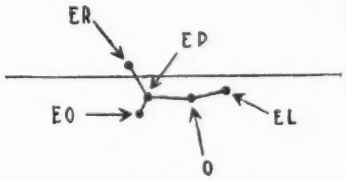

Fig. 47.—Left condyle. Path markedly convex downward, but the sliding movement is forward and upward. This was associated with great attrition on all the teeth.

EXPERIMENTS CONFIRMATORY OF THE PRINCIPLES HERE ENUNCIATED

I will now show how that by means of practical experiments I believe myself to have obtained proof of the correctness of my theory. It would be too circumstantial to go into the details of the many subordinate questions which properly ought to be considered in the explanation of the experiments I have made, of which I shall only briefly mention two.

The idea I have taken from R. Fick's. ("Ueber die Form der Gelenkflachen," 1890) method of showing that the joint-surfaces in the human organism, through the action of the muscles, may be said to receive a suitable form by grinding against each other. This method consisted in his causing plaster-of-Paris casts to move against each other by

means of cords corresponding to certain muscular spasms; this resulted in the casts assuming the same form as the corresponding joint-connections in the human body.

This method I adopted for my first experiment in the following manner: I first fixed two plaster blocks with plane ends in my "rational articulator," in such a manner that they fitted together in the resting position. I then gave the articulator's joint-path the specially oblique position which later on we shall see is the one corresponding to a curved bite-path, and carried and displaced them, maintaining a firm pressure against each other, through all the directions of the moving bite, so that they ground each other into shape. When, finally, the grinding was accomplished the surfaces presented the form seen in Figure 25, which is engraved after a photograph of the preparation. The worn surfaces now showed perfect contact during all bite movements and presented also apparently spherical surfaces. This "indirect

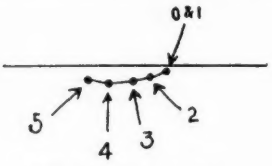

Fig. 48.—Left condyle.

proof" was confirmed by a similar experiment which I carried out on a living subject, a man whose natural teeth presented a somewhat worn, slightly curved, but for the rest a not very smooth bite-path. I covered the rows of teeth with thin pieces of rubber and melted on the bite surfaces of these—the upper as well as the lower—a layer of wax a few millimeters thick, and this I lubricated by the application of soap, and I now let him execute bite movements—consequently all possible displacements of the jaw—with the rows of teeth pressed lightly against each other.

Figures 26 and 27 which like Figure 25 are engraved on wood after a photograph, though the case is not very pronounced, show the result, which demonstrates the correctness of my theory just as plainly as the previous one. Both blocks have obtained the character of spherical surfaces, one concave and the other convex, corresponding to the lower and the upper part of the mouth. I do not claim that these experiments have been carried out with the absolute accuracy required in really scientific work, but, as already remarked, we are here aiming at a mere practical conception; and, practically, my experiments will at all events compare favorably with the accuracy with which the work as a whole, in artificial dentures, can be executed at all.

THE CONSTRUCTION OF A RATIONAL ARTICULATOR

If we now believe we have found the fundamental principle for the path of the bite movement in general, the next step is to see how by means of this we may be able to learn the exact individual form presented by the path in each special case. This leads us up to the question of the principle for the construction of a rational articulator.

In order to understand what is the essential in the construction of such an articulator,

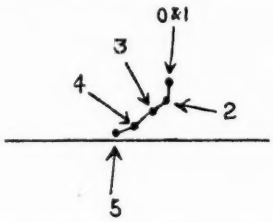

Fig. 49.—Left condyle. Figures 48 and 49 show relative positions of condyle at occlusion, and with mouth opened to extent of 1, 2, 3, 4, and 5 cm., respectively.

I will here try to explain precisely what is required of it:

The articulator must be the technical medium for presenting a correct view of the individual bite movement by means of the casts. That is to say: It must be possible by means of the articulator to bring the casts into the correct relative positions corresponding to the different phases of the bite.

This requires in the first place that the articulator's joint-mechanism imitate the very form of the condylar path as it is during the bite movement; and secondly, that this joint-mechanism and the casts may be brought into relative positions which correspond to the natural conditions in the individual in question.

Bearing this in mind, we will now look at the accompanying cranium, Figures 28 and 29, which by inscribed circular lines indicate the schematic profile of the form of the bite movement in two different supposed cases.

We will here first notice that the two joint-paths, *b, b,* in Figure 28 and Figure 29, with respect to actual form are almost alike, inasmuch as they both, though in a mathematical sense following circular lines, may yet, owing to their shortness, practically be said to follow straight lines.

From this we learn that it would be of very little importance to try to individualize the form of the joint-path itself in the joint-mechanism of the articulator. A joint-path following a straight line will in the articulator, in all cases, give a view of the natural form of the joint-path during the bite movement which is sufficiently accurate for practical purposes.

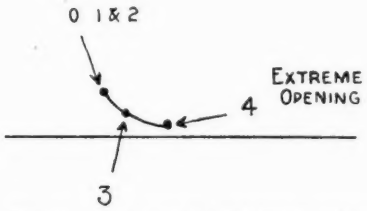

Fig. 50.—Right condyle. Relative positions of condyle at occlusion, and with mouth open 1, 2, 3, and 4 cm., respectively.

On the other hand we shall see that there is a remarkable difference between the position of the two joint-paths (*b, b*) in relation to that of the respective bite-paths (*a, a*).

While the joint-path in Figure 28 shows an inclination of about 45 degrees to the horizontal line, the joint-path in Figure 29 takes up an almost horizontal position. It will consequently be this individually different degree of inclination of the joint-path which must be considered decisive in determining the form of the bite-path, and which it is essential to learn precisely in the individual, and to be able to describe exactly in the articulator's joint-mechanism.

In order to illustrate more plainly this relation between the form of the bite-path and the direction of the joint-path, and also for showing how it is made possible to find and determine this relation individually, the Figures 30 to 35 are shown.

These figures are from photographs of a schematic phantom, which is made of a metal plate on which is cut and drawn the profile of a cranium with a displaceable lower jaw attached.

In this plate, at the approximate place of the jaw-joint, is made a slot shaped as a horizontal V and forming two straight-lined paths (joint-paths) running in different directions, but having their starting point in common. In this slot is placed the lower jaw by means of a metal pin soldered to the condyle and fitting the slot, so that it does not wabble; this allows the lower jaw to be carried into the different bite positions without wabbling.

These two paths, which on account of their positions I will call the "steep" and the "horizontal" joint-path, represent *two different joint-paths*—that is, in two different individuals—and they will very closely indicate the two extremes which it is possible for any degree of the joint-path's inclination to assume.

The parts of the upper and lower jaws in which are fixed the respective rows of teeth are, moreover, removable in order to admit different sets of teeth, with differing bite-paths, to be presented in the same cranium.

In Figure 30 the phantom shows a denture with a curved bite-path in resting position.

In Figures 31 and 32 is seen the same denture in forward bite position, but in Figure 31 the jaw is carried along the steep and in Figure 32 along the horizontal bite-path.

In Figure 33 we see the set of teeth used in the previous figure substituted by a set with a straight bite-path. The jaw is here in the resting-bite position.

In Figures 34 and 35 we see this set of teeth in forward-bite position with the jaw carried forward along the horizontal and steep joint-paths respectively.

In Figures 31 and 34 we see how the two different dentures retain perfect contact during forward bite, owing to their bite-paths being formed corresponding to the respective joint-paths along which the jaw is carried. In Figure 32 and Figure 35, on the other hand, we see how the contact during forward bite is made impossible if the bite-path and joint-path do not correspond with each other.

I presume that it will be unnecessary to give a further explanation of these imagined figures, which plainer than many words show the relation existing between the *inclination* of the joint-path and the *form* of the bite-path, and from which we can see that the deciding factor in obtaining the principle for constructing a rational articulator must be—that the joint-path of the articulator in each individual case must be capable of being adjusted to the correct degree of inclination; that is, adjusted to the position in relation to the casts corresponding to the natural condition in the special case.

The rational articulator must, consequently, be provided with sliding joints, by means of which the displacement path of the condyles during the bite movement may be imitated,

Fig. 51.—Lateral path register in contact with pencils. Another position for holding register steady.

and these sliding joints must be capable of being adjusted to different degrees of inclination in the sagittal plane (and independent of each other, because the inclination of the joint-path in the same individual is not always the same in the right and the left side).

As I intend in a later article to treat the practical side of the question, and in order to be brief, I shall not here go into the details of construction of the articulator, but only refer to my former publications on this subject, among others "A Rational Articulator" (*Ash's Quarterly Circular,* December, 1901, and *Dental Revy for Scandinavien,* 1902).

I shall, however, by means of the phantoms briefly endeavor to show how the individual inclination of the joint-path may be found.

If we look at Figure 35 (in which the displacing movement is carried along the steep joint-path), showing the set of teeth with the straight bite-path, we notice that an intermediate space between the rows of teeth has been produced by the forward displacement corresponding to the lowering of the back part of the lower jaw produced by the inclination of the joint-path. From this we see that the less steep the joint-path's inclination is, the less will the lowering of the jaw be, and the smaller will the space be backward between the rows of teeth shown.

In Figure 34, in which the forward-bite

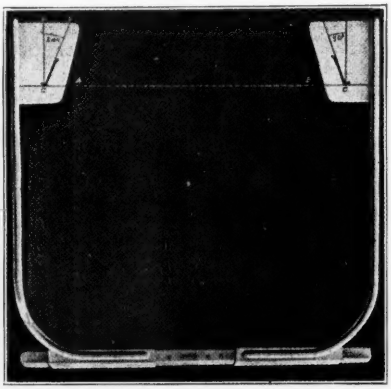

Fig. 52.—Lateral condyle paths recorded and strengthened. *A-B* line drawn from "resting point" in one path to "resting point" in the other, and perpendiculars erected at these points. Angles may be measured with the degree plate used for measuring forward paths.

movement is shown as carried along the horizontal joint-path, no space appears, as a matter of course, because no "lowering" of the jaw has taken place.

The relative positions occupied by the rows of teeth at forward bite express in this manner the change of position which has taken place with respect to the entire jaw; and this renders it possible to read off the direction, i. e., the degree of inclination of the path which the condyle must have followed during the forward displacement.

Every point of the lower jaw, and therefore also the point indicating the condyle, will, then, in the resting-bite position indicate a starting-point, and in the forward-bite position a terminus of the movement performed, and as far as the condyle is concerned this means that we have learned the direction of the line it has followed during the movement.

This geometrical experiment, which is here assisted by the schematic figures, is carried out practically by means of the "rational articulator" as follows:

get as near as possible to the natural relative distance. (Bonwill puts this distance at 10 cm. Even if this often varies, it is still a suitable mean distance. A divergence does not affect the form of the joint-path, because the out-swinging path of the condyles always resemble a straight line in the short length affected.) But exact imitation is not required so long as proper care is taken that the height of the bite is not changed.

When this is accomplished, the base plates will look as shown at *E*, Figure 36.

The base plates are then again placed in

Fig. 53.—Left: Marker in apex of gothic arch and mandible in centric relation. Right: Registering the lateral incisor path.

When by means of the trial plates we have secured the correct bite in resting position in the usual manner, and then fixed the casts in the articulator, we have secured the correct relative positions of the casts at resting bite, and have at the same time, in the articulator's joint mechanism, secured the determined starting-point for the movement.

We now turn to the next part of the problem,[18] the placing of the models in the correct relation to the joint-mechanism—that is, in the relatively correct relation. It is best to

the mouth, and at the same time a little lump of softened wax is fastened on the upper surface of the lower base plate at the back.

The patient is now requested to move the lower jaw forward until the front parts of the base plates meet, and then to bite. The back parts of the base plates will then—according to the varied lowering of the jaw during forward movement—be more or less apart, and the lump of wax lying between (see *D*, Figure 37), will give the exact measure of this distance.

The patient must keep the mouth in this position until, by incisions with a knife on the

18. Footnote 14, first reference.

wax blocks on the base plates, their relative positions are marked. When this is done the base plates are taken out of the mouth, cooled, and placed on their respective models in the articulator.

The upper part of the articulator is then taken hold of with one hand and the lower part with the other hand, the base plates are held in place, the lower part is moved forward, and an attempt is made to bring the base plates into the same position to each other as they took up in the mouth. In order to attain this it is necessary during the above process to move the arms—*C C*, Figure 38—of the sliding-joint into the required position with one of the fingers.

Having brought the base plates into correct position, the articulator is held firmly,

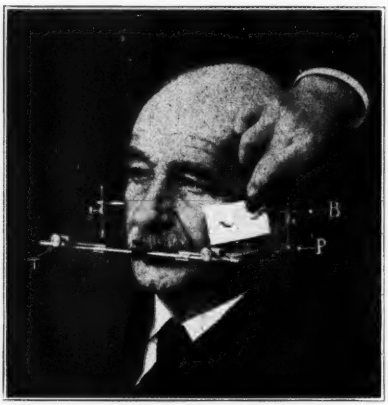

Fig. 54.—Method of determining slant and form of condyle path.

while the position of the sliding-joint is fixed by means of the set screws *C C*, Figure 37.

Figure 37 shows how the base plates in Figure 36 look after the bite forward has been made. The changed position of the sliding-joint will be noticed.

The articulator is now ready for the arrangement of the teeth, and if the above directions have been closely followed, it will be seen that when tried in the mouth the denture will articulate there exactly as it did in the articulator.

Indeed, it does one good to study the work of men so broadminded and so fair as were Walker and Christensen. Their work, if but for this one reason alone, is worth reading, that we may be inspired with the desirability and importance of first being honest with ourselves.

Norman G. Bennett, of England, rediscovered that the mandible in lateral movements shifts bodily in the horizontal plane as it swings laterally (Balkwill movement, Figure 8), i. e., the condyles move toward and away from the median plane in the direction in which the mandible swings. All present investigators

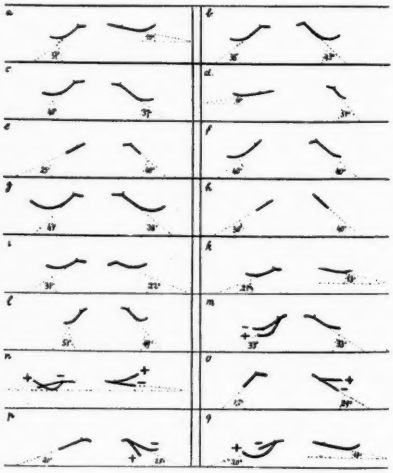

Fig. 55.—It does not often happen that both condyle path curves have the same form and slant. Some examples of the differences in form and slant between left and right condyle path curves in the same individual may be seen in Figure 55, *a* to *i*. The specimens in the same figure from *m* to *q* show that other differences may occur, either in only one or in both joints at the same time, between the path of the opening movement and the path of the lateral movement (*n* to *q*). For practical purposes only the path taken in the lateral movement possesses any value in the setting up of the artificial teeth for effective mastication, and therefore only this angle is measured.

except one, as far as I know, accept Balkwill's and Bennett's findings—the Balkwill and Bennett movement. The one exception is George S. Monson, of St. Paul, Minn.

Mr. Bennett recorded the movements of the several parts of the jaw by projecting the illumination of lights fixed over those points on the walls and ceiling. By an elaborate mathematical demonstration, he showed that the recorded movements could not be reproduced with the condyles as centers, but that the different movements had many centers in different locations. So wide apart were some of the locations that he doubted whether a practicable articulator could take cognizance of them.[19]

Campion[20] graphically registered (extra-oral method) the form (S or ogee shape) of the condyle path, corroborating the findings and record of Luce and

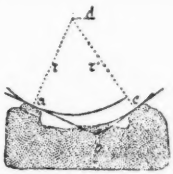

Fig. 56.—Cross-section of plaster cast of the natural lower teeth.

Walker in a spectacular as well as a practical manner.

Campion is credited with defining the opening and closing movement as a complex movement occurring about two axes, one through the centers of the curves of the articulator surfaces of the condyles and the other through the centers of the curves of the two eminentiae articulares.

Campion describes and illustrates his graphic, extra-oral condyle path registrations in such an interesting, brief and concise manner that I am quoting his entire article, verbatim. Please take particular notice also of what Campion has to say about the opening and closing axis of the mandible, imitating it in articulators and relating casts to it when mounting them in the articulator.

The problem of the exact elucidation of the movements of the mandible must be of interest to all dentists who are trying to achieve success in the construction of an anatomical articulator. The method here described of following these movements, and the accompanying graphic records of actual movements in the living subject, may, I hope, interest this section.

Fig. 57.—Cross-section of plaster cast of the natural lower teeth.

Figure 39 shows in position an instrument consisting of a small tray, shaped like a lower impression tray but without a handle, to the anterior border of which are fixed two brass rods. These issue from the mouth and are bent upward and outward to conform approximately to the contour of the cheeks. To each of them is fixed a plane surface of brass, the two surfaces on opposite sides of the face being arranged parallel to one another. On these slide two other plane surfaces, the positions of which can readily be adjusted and fixed by thumb-screws. Each of these movable planes carries a brass tube which can readily be fixed in a position exactly over the corresponding condyle after its position has been ascertained by palpation. By getting

19. Clapp, G. W.: Prosthetic Articulation, New York: Dentists' Supply Company, 1914, p. 142.

20. Campion, G. G.: Some Graphic Records of Movements of the Mandible in the Living Subject and Their Bearing on the Mechanism of the Joint and the Construction of Articulators, Dent. Cosmos, 47:39 (Jan.) 1905.

the patient to move the mandible from side to side the positions of the condyles can be determined with ease and the tubes fixed exactly over them. When the tubes have been thus adjusted they project from the sides of the face perpendicularly to the skin covering the condyles. A pointed piece of brass rod slides easily but accurately in the tubes, and after the instrument has been fixed rigidly to the lower teeth by modeling composition and the tubes accurately adjusted, the point of the sliding brass rod being charged with some coloring matter which does not readily dry (such as rouge mixed with oil to a creamy consistence), the varying positions of the condyles can be readily indicated by a succession of dots on the skin. A piece of white blotting-paper is then gently pressed over them, and from this the record can be easily

Fig. 58.—Cross-section of plaster cast of the natural lower teeth.

transferred to paper or a ground-glass lantern slide. By using a piece of blotting-paper about three inches long by one inch broad with a penciled line drawn along the middle of one surface from end to end, it is easy to record the relation of the condyle path to an imaginary line from the external auditory meatus to the lower border of the nose, and thus show approximately the relative slope of the condyle path in different individuals. The positions recorded explain themselves when it is stated that in those of extreme protrusion and extreme right and left the teeth were as nearly closed as the apparatus would permit.

The accompanying records (Figures 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50) of actual condyle paths in different individuals show wide variations — an almost straight line, sigmoid curves of differing lengths and curvature, and curves of unequal convexity. The slope of the condyle path also varies greatly, being usually downward and forward, but often nearly horizontal, in one case of those shown being forward and actually upward. Now, these variations in a number of unselected cases show at a glance how futile must be any efforts to construct an anatomical articulator on the lines of the Bonwill, Walker, Schwartz, Christensen, and Gritman, and that no articulator can be in any real sense "anatomical" in which the condyle paths are not capable of being specially arranged and adjusted for each individual case. To Mr. J. B. Parfit of Reading, England, belongs, I believe, the credit of being the first to construct an articulator which embodies this essential point.

Three other slides represent the positions of the condyle in occlusion and when opened

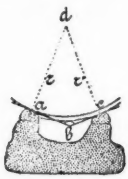

Fig. 59.—Cross-section of plaster cast of the natural lower teeth.

successively to the extent of one, two, three, four, and five centimeters—except, indeed, where the mouth could not be opened to this full extent. In obtaining these three tracings care was taken that in closing on the pieces of metal of these different measurements the mandible was not in any way protruded, but was held back as far as possible in the position which obtains in occlusion. It will be noticed in these tracings that the position of the condyle in occlusion coincides exactly in two cases with its position where the amount of opening is one centimeter, and in the third case with the position where the opening has been to the extent of two centimeters.

It has been suggested that in the movement of opening the mouth the mandible rotates about an axis situated about one and a half inches below the two condyles, and that an articulator should be so arranged that its

hinge should be placed in approximately a corresponding relation to the teeth of the case under treatment. From the various curves shown it would seem that both these conclusions are erroneous, and that there is and can be no one axis about which the mandible moves in opening the mouth, but that the movement is a complex one, consisting first of a rotation of the bone on an axis passing approximately through the centers of the two condyles, and secondly of a forward and downward movement of the condyles as they slide over or with the meniscus-shaped interarticular cartilage along the curve of the eminentia articularis. The actual movement would seem to be a complex one, consisting approximately of more or less simultaneous rotation about two axes, one passing through the centers of the curves of the articulator surfaces of the two condyles, the other through the centers of the curves of the two eminentiae articularis. It will also be clear that if in opening the mouth to the extent of one centimeter the movement is one of

Fig. 60.—Cross-section of plaster cast of the natural lower teeth.

rotation about an axis passing through the two condyles, then in adjusting models to an articulator they must be so arranged that the hinge of the articulator must be in the same relation to the teeth or alveolar processes as the centers of the condyles are in the living subject. The only part *of the opening movement* which an articulator is concerned to reproduce is the initial stage, which is seen in the tracings to be a simple rotation about an axis passing through the condyles.

Campion's last statement brings up a question that has been much debated in connection with articulators and the use of the face bow. Campion is correct under certain circumstances and very wrong under others. It is in connection with the opening and closing movement that the facebow applies and is used.

Gysi[21] was the first author to make graphic (extra-oral) registrations of Balkwill's and Bennett's movement for determination of the extent of this movement in degrees (Figs. 51-52). Gysi[22] was also the first to register the form and degree of the path of the movement of the incisor point (Fig. 53).

In making these registrations, Gysi corroborated Balkwill's and Bennett's findings as to the mandibular lateral movement (Fig. 8), and Walker's finding as to the variable centers of rotation for the lateral movements (Fig. 22).

Gysi also made graphic registrations of the form and degree of inclination of the condyle paths to the occlusal plane, corroborating Luce's, Walker's and Campion's registrations (Figs. 54 and 55).

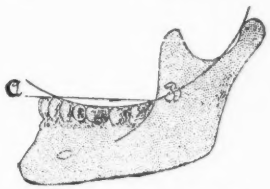

Fig. 61.—Curve of Spee.

Through Gysi's corroborative experiments and writings, he brought the work and ideas of the different investigators, authors and designers together and analyzed and elaborated on them in such a manner that both the subject and students of the subject have been greatly benefited thereby. The work, ideas and writings of Gysi, until recently, have been scientific, consistent and unbiased and have been of inestimable value. However, his later activities and writings are not so regarded. The latter statement will be substantiated in my paper on the analysis of articulators.

21. Footnote 20, pp. 173, 181.

22. Footnote 15, second reference.

Frank[23] conducted some very interesting experiments with which he showed that the center for the curve of Spee varied and that it varied between the two sides of the same mandible. The following quotations are taken from Frank's article:

The so-called anatomical articulators hitherto commonly used cannot by any possibility answer their purpose.

The arrangement of the denture is partly the result or expression of the movements executed by the lower jaw.

The inventors of articulators have supposed they could imitate the joint mechanism. If this supposition were correct, the imitated movements of articulators ought to produce an occlusion plane similar to the analogous occlusion plane of the natural denture. To prove the impossibility of this, let us examine more closely this plane in the natural denture. To do this I make use of models from living lower jaws, and make of these with a sharp saw transverse vertical sections, cutting in halves respectively the third, second, and first molars, and the second and first bicuspids on either side.

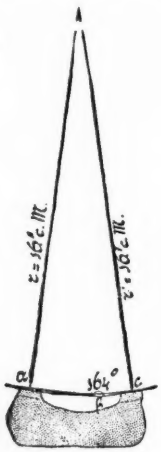

Fig. 62.—Cross-section of ground surface of lower occlusion rim.

These sectional views are represented in the Figures 56 to 60. If in these figures we draw lines, touching the highest points of respective pairs of molars and bicuspids, these lines will cut each other at a point *b*, and form an angle, *a*, *b*, *c*. This angle I will call the "interocclusal surface angle." If we erect half-way between the points of contact of each tooth (namely the points *a* and *c* on these tangents) perpendicular lines, these will likewise cut each other. This point of intersection *d* is the common centre of two circles. One circle with radius *r* is a circle of contact with the grinding surface of the right molar (or bicuspid), the other with radius *r'* is a circle of contact with the left molar or bicuspid. From the sections of numerous cases it appears that the radii of the two circles thus constructed for each pair of teeth are unequal.

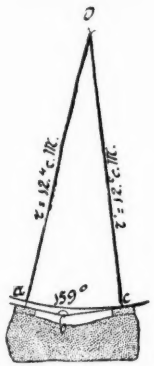

Fig. 63.—Cross-section of ground surface of lower occlusion rim.

I apply the following method for the calculation of the sagittal occlusion curves. I take an annealed thin narrow copper bar, press it carefully on the masticating surfaces of the side of the lower jaw I intend to measure, so that one edge exactly touches the surfaces of the bicuspids and molars and lies along their centres. Consequently, this edge represents the line of contact of the masticating surfaces in question. The edge of the copper bar is then placed on paper and carefully marked on it. In the usual mathematical way I draw a circle nearest to this

23. Frank, Bernard: An Investigation on Articulation and Experiments with C. Christensen's Articulator, Brit. Dent. J., 29:289 (April) 1908.

line. This is the sagittal occlusion curve of Spee, Figure 61; the radius of which can be measured directly. The great variety of the figures proves that any regularity in Spee's curve is absolutely excluded, whereas Spee says emphatically that the sagittal occlusion curve of man has a radius measuring from 6 to 7 cm. My experiments indicate that this is only the case in sixteen out of sixty measurements (i. e., 27 per cent). In one of these cases, the radius of the left occlusion curve had even a length of 21.2 cm. I mention the result of this series of measurements of the natural denture first in order to better compare them with the experiments applied by Professor Christensen to his own articulator. I repeated Christensen's experiment in order to compare the angle obtained with those obtained from natural dentures as above described.

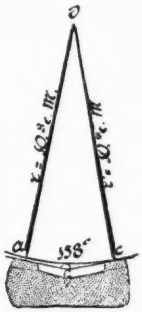

Fig. 64.—Cross-section of ground surface of lower occlusion rim.

He says that when we fix in the articulator two plaster blocks, representing respectively the upper and lower jaw, and grind them against each other by moving them by means of the imitated joint mechanism, we obtain a grinding surface corresponding to the natural masticating surfaces. This experiment was first made by Fick, and has been repeated by Professor Christensen (described in the *Dental Cosmos,* October, 1905). The result obtained in the experiment by Professor Christensen showed that the grinding surface of the supposed lower jaw is spherical. (For illustration of this experiment see *Dental Cosmos,* October, 1905.)

In repeating the experiment I used two pumice-stone blocks, each 1 cm. thick, which I fixed in plaster casts; for pumice-stone abrades easily, so that we can bring about the grinding by simply moving the joints of the articulator. Afterwards, I took a model of the grinding surface of the lower pumice-stone jaw, and made, at the proper distances, five transverse sections just as I did from the models of the thirty living lower jaws. Figures 62 to 66 represent these five transverse sections, at approximately the positions of Figures 56 to 60. The degrees of the interocclusal surface angles and the lengths of the respective radii are indicated in the illustrations. The radii of the sagittal curves (right and left side) measured 15.6 cm.

If we now consider the figures obtained with Christensen's articulator, the fact strikes

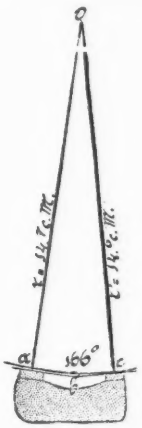

Fig. 65.—Cross-section of ground surface of lower occlusion rim.

us that the interocclusal surface angle of the first molars is smaller than that of the third molars, which, as a rule, is not the case in the natural denture, as we saw before. A similar difference is also to be observed in the case of the second molars. I think it is superfluous to point out more deviations, for the varieties in the figures obtained by measuring about thirty living lower jaws show clearly that every specific arrangement of the denture is partly the expression of the individual movement of the lower jaw, and chiefly of the development of the teeth. Though Christensen's articulator admits of some variation in its joint mechanism, the

deviations, demonstrated by my experiments, must necessarily occur with any other adjustment of the imitated joint mechanism.

The masticating surfaces of the various bicuspids and molars of one and the same lower jaw differ mutually in direction, so that there are ten different sloping surfaces (five for each side); each one of these surfaces has in every denture a character of its own. An anatomically perfect articulator ought to enable us to obtain in our experiments, by means of a complicated movement, a grinding surface representing the grinding surfaces brought about by the natural denture we intend to imitate. But it is evident that the directions of the natural masticating surfaces differ so greatly from those obtained by repeating the experiment of Christensen (as shown in the diagrams) that this experiment entirely fails to prove the correctness of the articulator. The articulation depends on

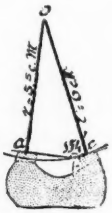

Fig. 66.—Cross-section of ground surface of lower occlusion rim.

the joint mechanism and on the shapes and positions of the teeth.

Fick and Christensen only reckoned with the movements of the joint mechanism and not with the shape and position of the teeth. To judge whether an articulator is able to imitate the natural movements of the jaw for each individual case the following experiments may be made:

First Experiment—Fix the models of a complete normally arranged denture (natural) in the articulator in such a manner that the relation of the upper and lower teeth to the articulator joint will be exactly the same as their relation to the natural joint. If the imitated joint mechanism acts well the slopes of the buccal cusps of the first and second lower molar teeth must slide in contact with the buccal cusps of their opponents for at least 2 to 2.5 mm. during the imitation of the masticating process; in other words, the masticating surfaces have to grind each other in sagittal as well as in lateral direction.

Second Experiment—Arrange a full set of artificial teeth (upper and lower) in Christensen's articulator, so that by the action of the imitated joint mechanism you produce the masticating action, that is to say, the masticating surfaces must grind one another during movements in both sagittal and transverse direction. Of this arranged denture cut from the lower jaw, out of a plaster cast, five transversal sections just as in Figures 56 to 60. Now measure in the described mathematical way the interocclusal angles thus obtained and it will appear that these angles do not correspond to the natural ones. This

Fig. 67.—Central rotation axis (area) applies to animal as well as human skulls.

may be the reason why an artificial denture arranged in Christensen's articulator, or some other one, can articulate well enough in the articulator, but not in the patient's mouth. It is obvious that, if the angles do not correspond, the directions of the masticating surfaces do not correspond with the joint mechanism, nor with the different movements of the jaw. That Christensen is on the wrong path also appears from his method of mounting the plaster blocks in his articulator. It seems to me that he mounted them at random, without regarding the relation of the entire occlusion plane to the joint.

In view of all these facts, it seems clear that it is utterly impossible to solve the problem of articulation by means of articulators. Moreover, any one who feels inclined to spend time and trouble on it can multiply the proofs of my assertion by a series of experiments such as those I have just described. If we further consider that the distance of the supposed condyles from one another in Christensen's articulator, and I believe in all the others, are constant, the question may well arise whether this can be right for all cases. When we measure a number of mandibles, we find that the distances of the condyles from one another vary greatly. The

Fig. 68.—Central rotation axis (area) applies to animal as well as human skulls.

greater the distance between the condyles the greater must be the curve along which we have to arrange the masticating surfaces of the denture. For this reason, too, the articulator is unreliable. An artificial denture cannot answer to the physiological articulation when the masticating surfaces are not arranged along the proper transverse and sagittal occlusion curves. An artificial denture should be arranged so that the mandible can execute all the movements required for mastication, and the masticating surfaces do not lose their contact: only when this aim is reached may we say that the denture articulates well.

The questions which call for answer are the following:

1. Does the articulator, of whatever construction it may be, give us any indication as to how to set up an artificial denture? No.

2. Is any articulator so constructed that we can fix the models in correct relation to the joint mechanism and to a certain predetermined horizontal plane, as in Figure 61 *a b*? No.

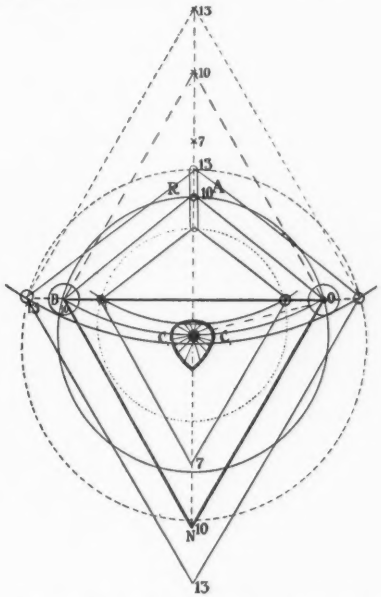

Fig. 69.—Bonwill double triangle of three sizes, 7, 10 and 13 cm., respectively.

3. Does an imitated joint mechanism act like the natural joint mechanism? No.

What, then, is the use of a so-called anatomical articulator? An anatomical articulator is good for nothing. Life cannot be imitated.

It would seem, then, that we must give up forever any idea of being able to construct a mechanical joint articulator which will enable us to construct a physiologically articulating denture for each individual case.

Hillyer[24] describes and comments on "Schweitzer's projected articulator" as follows:

For many years one of my valued associates at the New York College of Dentistry, Dr. H. Schweitzer, has been investigating this subject of articulation, and has devised an articulator which also differs radically from all others, in that the rotation point of the mandible is placed at the position of the vertebral axis. This conclusion was reached after the examination of many hundred articulated skulls, and, as can be seen by these specimens (Figures 67 and 68), applies to animal as well as human skulls. The movements of the mandible, as all investigators have found, have been so difficult to control that if it were possible to obtain an instrument which would furnish a fixed rotation point, much would be gained. Dr. Schweitzer

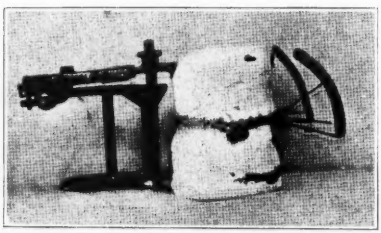

Fig. 70.—Schweitzer's central rotation point articulator.

has endeavored to geometrically prove his contention by constructing a double "Bonwill triangle" (Figure 69), showing calculations upon three sizes of arches, 7, 10 and 13 cm. respectively. These triangles are constructed with a common base. Using the apex of the occipital triangle as a radiating point, he inscribed an arc through the condyle points. Bisecting this arc by a line bisecting the two triangles, the points of intersection furnished the centers of circles which when projected *were found in every case to pass through the center of the foramen magnum*—the position of the vertebral axis. Basing his deductions upon these facts, he constructed an articulator (Figure 70), having a fixed point in the region of the vertebral axis, adjustable by facebow to the requirements of a given case. The bite relations are registered by an incisor path guide and a molar path guide. While this articulator is still in a somewhat unfinished stage, the projected articulator will certainly offer some unique features to apply to the practical restoration of teeth in their true anatomical relation.

Note that Hillyer thinks very well of the central rotation point idea.

Snow[25] corroborates Christensen's, Frank's and Schweitzer's central rotation axis ideas, as follows:

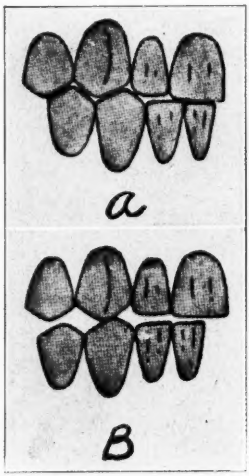

Fig. 71.—Teeth in right lateral occlusion.

When the Gritman articulator was devised, advantage was taken of the fact that when the mandible was alternately moved laterally, the lower incisors will have a path somewhat as though they were swung from a point located in the mesial line of the face, near the forehead. A large number of experiments were tried, and the inclination of the condyle path was in this way ascertained. But it was apparent that the method used for obtaining the inclination was unsuitable

24. Hillyer, Ellison: Development of the Anatomical Articulator, Dent. Cosmos, 55: 989 (Oct.) 1913.

25. Snow, G. B.: Present Status of the Articulator Question, Dentist's Mag., 2:635 1906-1907.

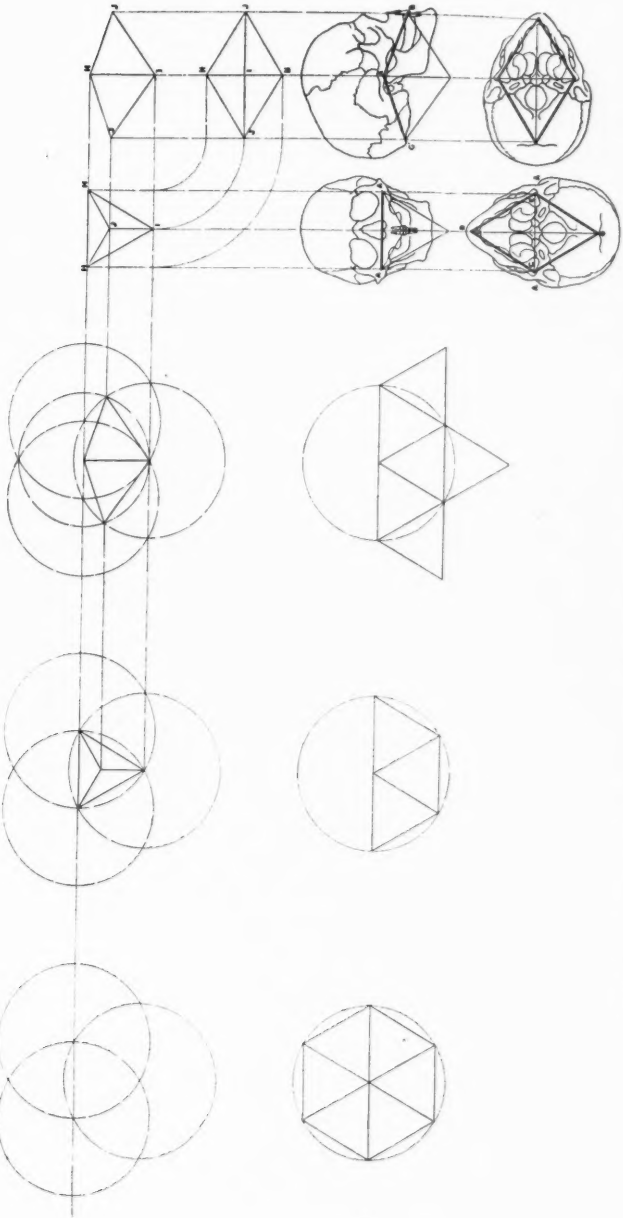

Fig. 72.—Geometrical theory of the design and movements of the masticatory apparatus.

for ordinary dental practice. The average was taken, therefore, and the articulator set accordingly.

In 1914, I introduced ideas[26] of mandibular movements that corroborated the ideas and statements of Christensen, Frank, Schweitzer and Snow.

My conclusion that the lateral movements of the mandible occurred about a central axis (area) rather than about a right and left axis, was arrived at because of the observation resulting from the following experiment:

A test set of dentures constructed in the Gysi adaptable articulator adjusted

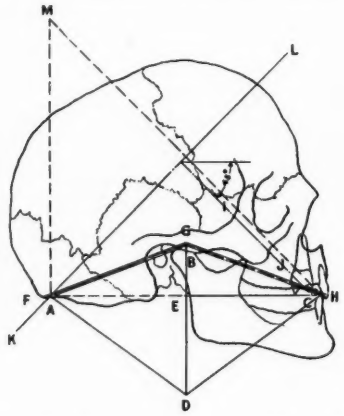

Fig. 73.—Geometrical theory of the design and movements of the masticatory apparatus, showing the cone *AMC*.

to the patient's individual mandibular registrations failed completely and absolutely to function in the mouth when tested with the normal, masticating movements of the mandible in anything like the same relations that they did in the articulator.

The completed, ground-in set of dentures in the articulator, presented the relation shown in *A*, Figure 71, when in lateral occlusion. When found not to work so satisfactorily in the mouth, the occlusion was again ground in directly in the mouth by having the patient chew carborundum, and when completed and in lateral occlusion, the case presented the relation shown in *B*, Figure 71, a relation which was obviously established by a central axis or arcuate lateral movement of the mandible.

These views were taken from Gysi's articles published in *Dental Cosmos* in

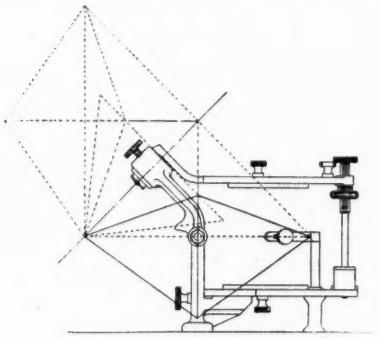

Fig. 74.—Hall articulator.

1910, and Gysi states that *A* is correct (normal) relation of the teeth in lateral occlusion and that the relation shown in *B* is incorrect. For fifteen years, I have been contending that the reverse of Gysi's interpretation and statement is true.

Following the foregoing test, Bonwill's theory of the equilateral triangle and geometric solution of the movements of the mandible was revived and supplemented by me.

My geometric theory of the mandibular movements was based on an ex-

26. Hall, R. E.: Movements of the Mandible and Approximate Mechanical Imitation of These Movements for the Arrangement and Grinding of Artificial Teeth for the Efficient Restoration of Lost Masticatory Function in Edentulous Cases, J. N. D. A., 7:677 (Aug.) 1920.

tension of Bonwill's discovery that the ground plan of the human masticatory apparatus is the equilateral triangle (Figs. 72, 73 and 74).

This theory and articulator purported to demonstrate that the condyles are not the guide to the movements of mastication, but are merely the fulcra upon which the mandible moves; that the occluding planes of the teeth are the guides for the mandibular movements. (I have since modified my ideas and claims as attested in paper "Full Denture Construction"[13]). This theory took into consideration the fact that movements occurring when planes of two or more teeth are in contact are masticatory movements and are of importance to the prosthetist. The extent of these movements was considered so slight as to confine the movements of the condyles to the glenoid fossa, the assumption being that the path of the condyle on the eminentia articularis was movement out of or beyond functional occlusion of the teeth and had no bearing on or importance in connection with the arranging of the occlusion of the teeth. In line with this idea, and recognizing the coordinate relation between the movements of the mandible and the planes of the teeth, my theory adapted the mandibular movements to the planes and positions of the teeth, and not the planes and positions of the teeth to the condyle paths.

The lateral movements of the Hall arbitrary articulator were automatically either gothic arch or arcuate in character. This movement was also given the name "conical" movement (*A M C* Fig. 73).

Testing the movements of the articulator constructed upon the theory of the cone to ascertain the character of curves its movements would cut (Christensen test) produced the typical tooth curves observed in the natural teeth and reestablished by edentulous patients on chewing carborundum and plaster occlusion models (Christensen test also). (Fig. 75.) Thus it was concluded that the movement of the mandible was conical and that the movement of the articulator constructed upon the theory of the cone was correct in principle.

Fig. 75.—Curves cut in plaster and carborundum occlusion models by both the articulator and the living subject.

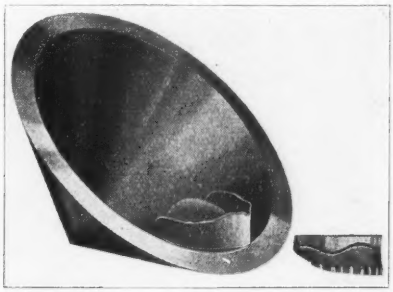

Fig. 76.—Curves of the upper teeth conform to the inner surface of a cone.

The curves of the upper teeth, which guide the movements of the mandible, are shown, faintly, to fall on the inner surface of a cone (Fig. 76), and the movement of the articulator constructed upon this premise, as it is shown, cuts or grinds these curves. No other figure has been shown to fit this specification, in

spite of the theory of the cone having been ridiculed and passed into the discard. The sphere, for example, demonstrated by Christensen (Fig. 25) and later used by Monson and Wadsworth, accounts only for one curve, that of the curve of Spee of the lower teeth and not the two intersecting curves of the upper teeth, characteristic of and present in all dentitions of natural upper teeth.

While the cone appears to be of some significance in this connection, and in this respect fits better into the proposition than the sphere, I do not think the theory has been substantiated sufficiently to justify use of it in any way.

pating, as it were, the height of the cusps and overbite of the teeth.

STANSBERY'S THREE DIMENSIONAL CHECKBITE TECHNIC

Following is an illustrated description of Stansbery's checkbite technic, quoted (including cuts) from his article.

The construction of baseplates and occlusion rims and the taking of the bite in the usual way, and the mounting of the casts in a plane line articulator are preliminary steps in the Stansbery checkbite technic. The vertical distance (intermaxillary space) must be accurately determined in the preliminary bite, as this

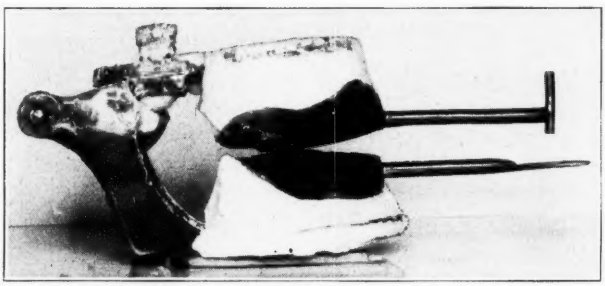

Fig. 77.—A step in the laboratory technic. The bite-rims are replaced by the curved plates of the checkbite set. These plates must be in contact as shown to preserve the vertical dimension. The graph plate is smoked; the soot protected by a thin film of wax, and attached to the lower base-plate. The stylus is attached to the upper.

Stansbery[27] recently upset all past practices and revolutionized the procedure of securing registrations of mandibular relations by providing in his new technic means for registering edentulous mandibular relations as in function; i. e., registrations of the relations of the mandible that include the opening and closing movement in estimated ratio as will obtain when the teeth are inserted, anticidistance, once accepted and the checkbite taken accordingly, cannot be changed.

The preliminary bite-rims on both upper and lower bases are reduced in height to receive two curved plates, as shown in Figure 77.

In the lower plate at the point of tangency, a round-headed screw threaded in millimeters is inserted from the under side. Each full turn raises its head above the upper surface 1 mm., and therefore forces the curved plates apart (Figure 78). This round-headed screw, in its raised position, takes the place of the cusps in the finished denture and acts to force the mandible into a position below that of centric occlusion while in the protrusive and

27. Stansbery, C. J.: Functional Position Checkbite Technic, J. A. D. A. 16:421 (March) 1929.

lateral positions. This screw, normally flush with the surface of the lower plate for the correct vertical dimension of centric occlusion, may be raised to any degree to separate the plates for the requirement of the particular case at hand in accordance with the cusp height of the teeth being used or the overbite deemed advisable. While still mounted on the plain line instrument, the tracing-pin, or stylus, and smoked graph plate are attached to the labial surfaces of the bite-rims as shown in the illustration (Fig. 77). In this checkbite technic, the tracing by the stylus on the smoked graph plate is no integral part of the checkbite. All the relations which we seek are contained in the checkbites themselves, and the only function of the tracing is to make the various positions of the mandible readable to the operator. The objective of this checkbite technic is to register the relationship of the upper and lower ridges in the exact functional positions which they will occupy when the dentures have been completed. To do this, more than the protrusive and lateral excursions on a horizontal plane from centric occlusion must be given consideration. In each of these excursions, the modifying influence of cusp height must also be registered. (Fig. 79.)

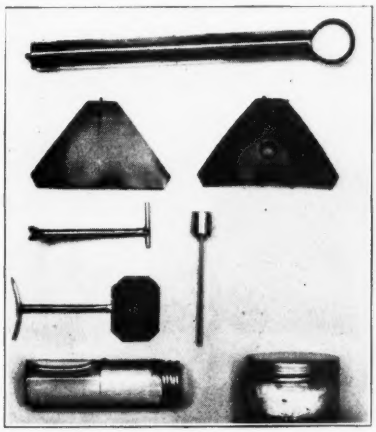

Fig. 78.—Checkbite set. (For the use of these parts refer to Figures 77, 80, 82 and 83.) It is more convenient to pour the mixed plaster into the syringe than fill by suction. The two measuring glasses assure the proper proportions for consistency and time of setting.

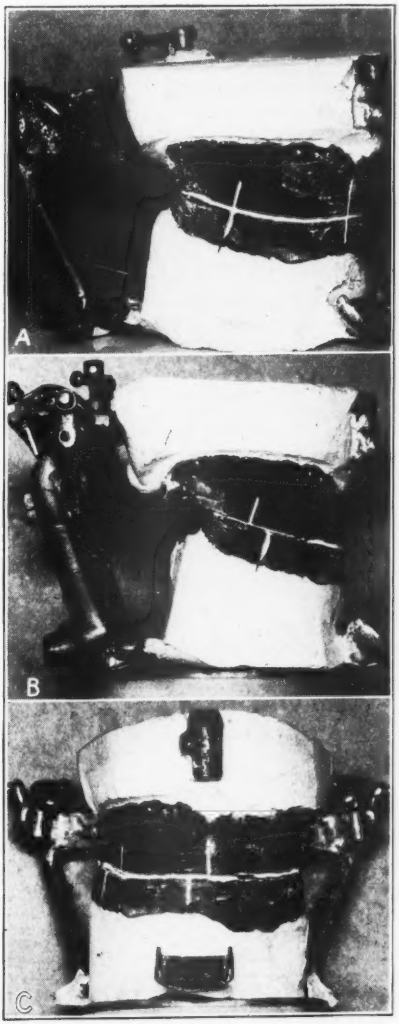

Fig. 79.—Method commonly used with bite-rims. *B* and *C* show the two relations which the mandible cannot assume on account of cusp interference. Why register these impossible positions?

The next step is at the chair. The baseplates and bite-rims are placed in the mouth with the curved plates in contact, or the screw in its lowest position. (Fig. 80.) These highly polished surfaces are lubricated with cocoa butter to eliminate all friction, which makes it impossible for one plate to exert any horizontal force upon the other; vertical force only can be exerted. The patient is now instructed to maintain a constant, moderate biting force and put the mandible through movements of protrusion and retrusion. From the retruded position, the patient is asked to move the mandible first to the right, to return to retrusive position, and then to the left; all these movements being recorded by the stylus on the smoked plate. Fig. 81.) These recorded movements have nothing to do with the technic other than to proclaim to the operator the position of the mandible; and his only task is to look at

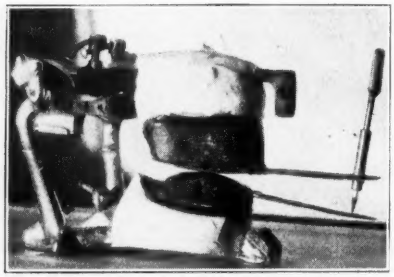

Fig. 80.—Simplex articulator representing the patient. The baseplates and checkbite are set in the proper position for the registration of centric relation.

them and understand what they mean. If the retrusive position affords also the correct centric relation, the two movements, one to the right and one to the left, will record tracings, both beginning at the retrusive point and forming an angle with each other. The design will be an arrowhead outline, or gothic arch. Once more, the patient is asked to assume the retrusive position, which is to be verified by the stylus being at the exact apex of the arrow. While it is held perfectly still in this position and under a moderate biting force, a quick setting mix of plaster of Paris is injected into the space between the curved plates. (Fig: 82.) A solution of one part of saturated solution of potassium sulphate and one part water, used with "plaster No. 1," to give an initially watery mix, is very satisfactory for this purpose. (Fig. 78.) Sufficient plaster should be used that the checkbite produced is a double concave disk. This is the registration for centric occlusion. In lectures at this point, I am often asked if these tracings are not hard to make. Usually they are very easily made, but occasionally we have a patient with but little voluntary control, and it then requires some watchful waiting on the part of the dentist while the patient makes the tracings. Even so, these tracings are the hardest part of the technic; so we graciously allow the patient to do them for us.

The baseplates are now removed from the mouth and the screw is elevated to represent cusp height. They are again placed in the mouth and the movements before described are repeated. (Fig. 83.) The cusp height introduced between these plates will cause

Fig. 81.—Tracing on the smoked graph plate.

the arrow design to be advanced on the smoked plate, usually about 1.5 or 2 mm. (Fig. 81.) The patient is asked to close in a lateral position so that the stylus lies exactly on one of the lines describing the arrowhead, one-quarter inch from the apex; and while under the same biting force as before, plaster is again injected between the curved plates. The quarter inch of lateral movement from the apex is necessary for a movement of one-eighth inch in the first molar region, which is the distance the buccal cusp of the lower molar travels laterally to come into apposition with the buccal cusp of the upper molar in assuming the position of working bite; the molar teeth occupying a position half way from the center of movement to the tracing. This procedure is now repeated for the opposite side. The fourth and

last, or protrusive relation is determined when the stylus lies in a position directly back of the apex at a distance equal to the over jet which is to be built into the dentures. (Fig. 84.)

Our information is now complete: the registrations of the four major positions of the mandible—centric, right and left excursions, and protrusion—and it must be noted that we have dealt with nothing except the positions of the alveolar ridges. Condyles and condyle paths have not been mentioned; opening axis

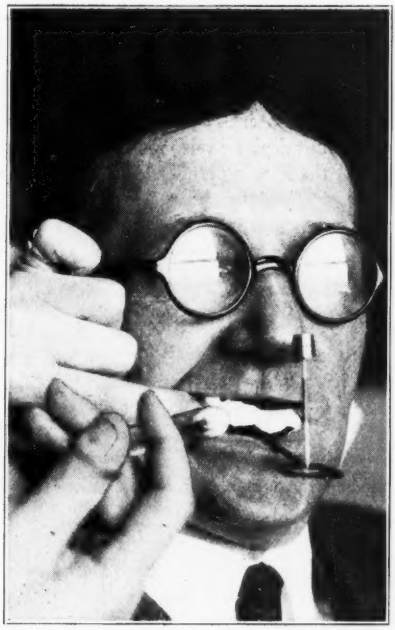

Fig. 82.—Method of plaster injection.

and axes of lateral movements have also received no attention. Bennett movements, various orientations, rotation points, quints, lateral shifts, the facebow, occlusal plane, compensating curve, curve of Spee, basic lines, anterior components and the naso-optic-condylar triangle are conspicuous by their absence. Many other terms have been omitted, terms invented in good faith to describe some phase of anatomic geometry, whose understanding was thought necessary to the proper construction of dentures, but which served only to complicate and confuse.

Stansbery's checkbite technic furnishes the basis on which I am going to prove that the normal masticating lateral movement of the mandible is about a central axis or area and not about a right and left axis, the prevailing idea that has dominated this phase of mandibular research work and articulator construction from the beginning of the development of the articulator.

In securing Stansbery's eccentric checkbite relations of the mandible, with the bite opened a distance greater than that established in securing centric relation of the mandible to allow for the cusps

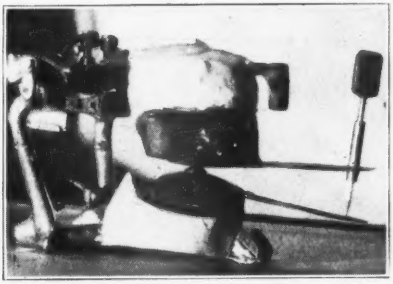

Fig. 83.—The screw raised to represent cusp height for the registrations of the eccentric relations. (Compare Fig. 80.)

and overbite, it is observed that two approximately parallel gothic arches are produced, one in each elevation (Fig. 81).

With the aid of Stansbery's double gothic arch tracing, for which I can not thank him too much, I will now show that the arcuate (central rotation axis or area) character of lateral movement, believed by Christensen, Frank, Schweitzer, Snow and me to be the normal lateral masticating movement of the mandible, and thought favorably of by Hillyer and demonstrated by Snow, is

the normal lateral movement of the mandible.

Figure 85 diagrammatically illustrates movement of the incisor point in lateral movements of the mandible, as referred to the horizontal or occlusal plane, of both gothic arch (*A B A* and *C D C*) and arcuate character (*E E*), either of which is made by the mandible when in function with cusp teeth and overbite present, requiring, as the teeth do, an opening movement of the mandible. I interpret the gothic arch movement of the mandible to be prehensile movement which has incorporated in it more or less of the protrusive movement. I interpret the arcuate lateral movement to be

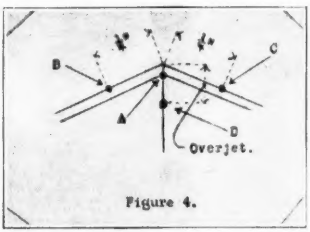

Fig. 84.—Diagrammatic sketch of the tracing on the graph plate with the positions of the stylus indicated by *A*, *B*, *C* and *D*, for the four major functional positions of the mandible.

masticating movement without any of the protrusive movement incorporated in it. The arcuate movement of the mandible, while not new, has never been understood or accepted by the profession. As evidence that this movement is made by the incisor point in normal masticating function of the mandible, I offer the following geometric demonstration, which I presented at the last meeting of the Illinois State Dental Society in Springfield, May, 1929.

THE DEMONSTRATION

In this demonstration it is observed that the lateral movements of the incisor point, describing the gothic arch tracings, are limited to movement made within the approximate range of masticating function of the teeth, *F F*, a movement which is estimated not to exceed three-thirty seconds inch to either side.

Gothic arch *A B A*, 1, applicable to 2, 3 and 4 (enlarged for convenience), is Gysi's arch, gothic arch *C D C* is Stansbery's arch and *E E* is my arc (arcuate movement). As is well known Gysi's arch *A B A* is developed with the mandible moving laterally in centric relation in a horizontal plane without incorporating any of the opening movement of the mandible required to clear the depth of the sulci of the cusps and the overbite of the teeth; whereas, Stansbery's arch *C D C* is developed as a subsidiary arch by and as a result of opening the mandible (bite) a distance estimated to be equal to the depth of the sulci of the cusps and the overbite of the teeth to be used in the case.

B, the apex of the Gysi arch *A B A*, developed with the mandible closed, is the centric positional relation of the mandible (Gysi).

Stations *F F* of Stansbery's arch *C D C* are the two limited lateral masticating positional relations, respectively, of the mandible with the mandible opened to accommodate the depth of the sulci of the cusps and the overbite of the teeth (Hall).

F B F and *D* are the right lateral, the centric, the left lateral and the protrusive relations, respectively, of the mandible registered as in function to anticipate and to accommodate the depth of the sulci of the cusps and the overbite and centric occlusion of the teeth (Stansbery). The space or area included in the outline

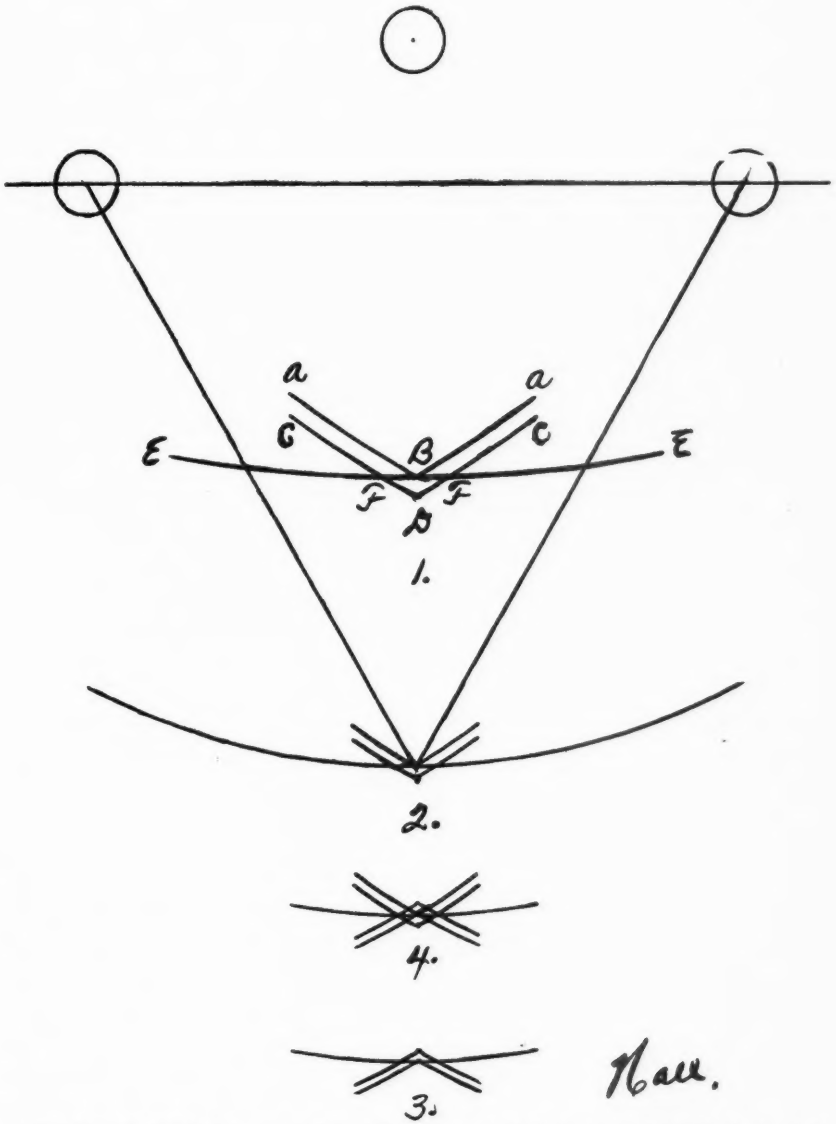

Fig. 85.—Geometrical demonstration of the movement of the incisor point in the horizontal plane with the movement of the point confined to the horizontal plane (two dimensional movement) and also with the movement of the point including vertical movement (three dimensional movement).

represented by the curves designated with these symbols is the incisor-point envelop (Hall).

AN ANALYSIS OF FIGURE 85

It is obvious that if *B* is the resting position of the point of the path marker with the mandible in the closed position of centric relation, the marker point would, if the mandible were progressively closed as it moved from a lateral relation *F F*, move to *B* and describe arc (Hall's) *E E* in place of a gothic arch as it does with its movements confined to a horizontal plane.

Thus, it is shown that Gysi's gothic arch applies to lateral movements of the mandible in centric relation confined to two dimensions or the horizontal plane only, the third dimension (opening movement of the mandible) not being accounted for; and that as a premise for articulator masticating movements the gothic arch is, therefore, not complete or acceptable. Such a movement (two dimensional) as that describing the Gysi gothic arch is impossible in nature unless the cusps and the overbite of the teeth are ground away. An articulator based upon such a premise, as made, recommended and used by Gysi, is suitable then for use with teeth without cusps and overbite only, in which case a plane line articulator is all that is needed as explained in my article "Full Denture Construction"[13] in connection with the use of inverted cusp (cuspless) teeth.

It is the practice to attach the path marker to the (maxilla) upper baseplate and the graph plate to the (mandible) lower baseplate in registering the gothic arch tracing, in which case it is to be understood that the tracings so registered are the reverse of the actual movements of the mandible. *1* and *2* show views of the double gothic arch tracing made with the path marker attached to the upper baseplate. As explained, the movements indicated by the tracings *1* and *2*, are the reverse of the actual movements made by the mandible. *3* shows the double gothic arch tracing made with the path marker attached to the lower baseplate, producing tracings that indicate the actual movements of the mandible. *4* shows gothic arch tracings *2* and *3*, superimposed upon each other, either being equal to the other and to the same thing. Gysi[28] showed one gothic arch tracing superimposed one upon the other in the same way as is shown in *4*.

Fig. 86.—Arcuate tracing secured with the masticating movements of the mandible (three dimensional movements).

Fig. 87.—Gothic arch tracing secured with the movement of the mandible (same subject as in Figure 86) restricted to the horizontal plane (two dimensional movements).

28. Gysi, Alfred: Some Essentials to Masticating Efficiency in Artificial Dentures, Dent. Digest, 36:669 (Nov.) 1920.

The exact dimensions and relative relations of the movements demonstrated in these illustrations are arbitrary, and are subject to varying dimensions and relations according to individual mandibular dimensions, relations and movements. However, the principle of the demonstrations applies in any case.

Figure 86 shows the result of a practical test made of the movement of the incisor point of my own mandible, the normal lateral three dimensional masticating movement, which I prepared and presented before the National Society of Denture Prosthetists at the Detroit meeting in 1927.

A stylus (path marker) was secured to the labial surfaces of the upper anterior (natural) teeth perpendicular to the occlusal or horizontal plane and a graph plate was secured to the labial surfaces of the lower teeth with its surface parallel with the occlusal plane so that the presence of the equipment in no way interfered with the functional occlusion of the teeth. A tracing of the lateral masticating movements was thus secured, presenting the outline shown in Figure 86, which I designate arcuate in character and offer as proof that the normal masticating movement of the mandible is arcuate in character rather than gothic arch.

Limitation of the movement of the incisor point to three-thirty-seconds inch to either side, as in the gothic arch demonstration, discloses that the movement of the point (tracing) is one at right angles to the median or sagittal plane and appears to be a straight line, which, as stated, I interpret to be arcuate in character and not at all one of gothic arch character.

That the movements of my mandible are normal, I offer proof in Figure 87, which shows the usual typical gothic arch tracing secured with the movements of my mandible confined to a horizontal plane on a graph plate mounted upon the lower teeth, which throws the occlusion out of function and permits movement in a horizontal plane. Were I to be fitted with dentures constructed to function according to the gothic arch record, Figure 87, with cusps and overbite, my actual functional movement in turn would call, as shown by Figure 86, for an entirely different form of occlusion accommodation and the dentures would prove a failure as they did in the test case told about in connection with Figure 71,[27] and as are all dentures so constructed in greater or less degree, depending on the extent of spot and mouth grinding done to correct them to approach or to conform to occlusion accommodation demanded according to the demonstration (Fig. 86).

I believe that I have made clear the point that the gothic arch two dimensional movement as a premise for articulator movements is erroneous. Articulators, then, the analysis of the movements of which shows them to move upon the gothic arch principle of movement as a premise, so claimed or otherwise, and to be limited to this (two dimensional) character of movement, will be regarded as basically wrong and useless in my analysis of articulators to follow this paper in a subsequent issue of THE JOURNAL.

THE DENTAL HYGIENIST: HERE AND THERE*

By EVELYN C. SCHMIDT,† Chicago, Ill.

MAY we, for the sake of our own convenience, reverse the latter part of the title of this paper and begin with the dental hygienist "there," gradually traveling northward, southward and eastward until we reach the dental hygienist "here," for it is from the geographic aspect that "The Dental Hygienist: Here and There" will first be viewed.

Seven league boots will take us to New Zealand, where the dental hygienist, or dental nurse as she is called, is trained by the government to work for the children in the schools. The course is two years, and there is no tuition, the student pledging to remain in the employ of the government for three years after being graduated. The curriculum includes many of the subjects found in a representative course in this country, besides instruction in the filling and extracting of deciduous teeth and the filling of first permanent molars. This statement is undoubtedly so startling to many members of the dental profession in this country that it might be repeated effectively. But let it serve as an anticlimax to the fact that several dentists, some connected with training schools for dental hygienists, and others, ardent sponsors of the movement in this country, have told me that they believe that the time will come when the field of *our* dental hygienists will include not only educational and prophylactic work but also the filling and extracting of deciduous teeth and the filling of first permanent molars. According to their idea, the hygienist would then be employed primarily in public health work. Hygienists in private practice would be limited to educational and prophylactic work. Supply and demand is the basis for their prophecy, for it is a notorious fact that there are not enough dentists to care for every one, and many dentists do not care to work for children. Evidently, the New Zealand plan is working out satisfactorily there and is forming a strong and important link in the public health chain.

Hawaii is our next stop; and Hawaii also puts us to shame. Through the interest and generosity of Mrs. Carter of Hawaii, Dr. Alfred C. Fones of Bridgeport, Conn., was invited there to map out and begin a dental health program for the Islands. One of the first steps was to establish a training school for dental hygienists, supervised by a graduate from the States, from Rochester Dental Dispensary. Hygienists from this country were employed for the school program also, which gradually was turned over to native girls as they were trained. Naturally, the program and the training course were similar to the original work which Dr. Fones developed in Bridgeport. At present, the Hawaiian

*Read before the Annual Meeting of the Massachusetts Association of School Dental Workers at Boston, Mass., May 6, 1929.

†Dental Educator, Department of Dental Education, Colgate, Palmolive, Peet Company.

course is a two-year accredited course at Teacher's College, the dental hygienist having the same rating, salary and regulations as the grade teachers. An educational and prophylactic program is being carried on in the schools.

In Sweden, there is a training course for dental hygienists, established, at the request of the government, by a Swedish girl who was graduated from the training school at Columbia University.

Aside from the three countries mentioned — New Zealand, Hawaii and Sweden—I know of no country outside our own in which the dental hygienist, as we know her, is trained. Canada has a training course for dental assistants at the University of Toronto; England, Germany, Japan and France have dental assistants or dental nurses, but none of these workers is comparable to our dental hygienist.

From "there" let us step "here," to this country. The first school for training dental hygienists was established in Bridgeport, Conn., in 1913, by Dr. Alfred C. Fones. In sixteen years, the courses have increased from one to thirteen. Following is the list: Atlanta School of Oral Hygiene, Atlanta, Ga.; Columbia University, New York City; Forsyth Dental Infirmary, Boston, Mass.; Marquette University, Milwaukee, Wis.; Northwestern University, Chicago, Ill.; Rochester Dental Dispensary, Rochester, N. Y.; Temple University, Philadelphia, Pa.; University of California, San Francisco, Calif.; University of Michigan, Ann Arbor, Mich.; University of Minnesota, Minneapolis, Minn.; University of Pennsylvania, Philadelphia, Pa.; University of Tennessee, Memphis, Tenn.; University of Southern California, Los Angeles, Calif. Two of the courses are for two academic years.

Connecticut was the first state to license the dental hygienist. There are now twenty-eight states that have licensing laws: Alabama, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Iowa, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Washington, West Virginia, Wisconsin and Wyoming, and the District of Columbia.

In no two training schools do the curriculums correspond to any other two, a fact which undoubtedly impedes the movement. It is to be hoped that, in the near future, the directors of all of the training schools, the deans of the dental colleges with which the courses are affiliated and perhaps such instructors as are interested in the development of the dental hygienist movement may meet to discuss requirements, curriculums and standards. Nothing but good could accrue from such a meeting if it were entered on in the proper spirit.

Nor do the laws governing dental hygienists in the various states correspond in the slightest degree. The preliminary educational requirements vary from "none" to "a diploma from an accredited high school." In some instances, the license of the hygienist may be revoked "for cause" by the state board of dental examiners or a corresponding dental group; while, in other states, the question of revoking a license is not mentioned in the law. Ten states offer reciprocity with states having equal requirements; the remainder do not specify whether or not there is reciprocity. All states licensing the hygienist allow her to practice in the office of a licensed dentist, two states limiting the work thereto. The other states add various fields including public and private schools, pub-

lic and charitable institutions, hospitals, industries and industrial schools. It is also specified that hygienists may be employed by state and municipal boards of health. The ages at which hygienists may take the state board examination range from 18 to 21. In one state, the age is not specified. The professional training necessary to take the state board varies from "none required" to "a diploma from a training school for dental hygienists—a two-year course." This will give you an idea of the variance in the laws. In view of the fact that the American Dental Association officially endorsed the hygienist movement at the annual meeting of that organization held in Los Angeles in August, 1922, it seems fitting that some committee already in existence, such as the Committee on Dental Education, or an especially appointed committee might help standardize the dental hygienists laws and classify the schools, just as the Dental Educational Council has been doing for the dental schools.

Throughout the country, dental hygienists are carrying on important pieces of work successfully. I shall mention only a few of these. Connecticut, Maine, Massachusetts, New York and Pennsylvania have dental hygienists with the state department of health. New York employs a dental hygienist in the state department of education. In several states, notably California, Maine, Massachusetts, Mississippi, New York, Ohio and Pennsylvania, the dental hygienist is used extensively in community health programs. It should be noted that every girl practicing in Pennsylvania must spend a year in public health work under Dr. C. J. Hollister, dental director of the state department of health, before she is allowed to practice in a dentist's office. California, Mississippi and Ohio have county traveling dental clinics conducted by dental hygienists under the supervision of licensed dentists. Five of the training schools for dental hygienists have hygienists as supervisors and the majority of the schools have hygienists on the staffs. Did time permit, we might open the doors of health centers, hospitals, industries and state, community and private schools in many states and see dental hygienists carrying on programs which have given complete satisfaction over a period of years. Nor can we overlook the multitudinous hygienists in private practice who have cooperated conscientiously with their employers to help bring prevention into dentistry.

For a few moments, let us hesitate here in Massachusetts. Those of us who were trained and worked in Massachusetts have reason to be proud of it. This state was the second to license the dental hygienist, after years of struggle by the advocates of the movement. The courses at Forsyth Dental Infirmary and at Rochester Dental Dispensary were started the year after Dr. Fones' experimental course. In so many states have I been told that "the first dental clinic for school children was established here" that I hesitate to say anything about that except that I hope one of the first was established in Massachusetts since it is so old a state—and yet active—and I believe it was. We may be proud of the fact that the Massachusetts Dental Hygiene Council was the first organized group of dentists to devote itself to the dental health of the public. Since the inception of the council, its members have been actively working for and on a program for the betterment of dental conditions in this state. In 1918 and 1919, one of the members, Dr. Edwin N. Kent, gave part-time service, gratuitously, to the division of hygiene of the state department of

public health in order that a dental health program might be developed under official auspices. It was through the efforts of the members of the dental hygiene council that Massachusetts was the first state to have a full-time dental worker with the state health department. Other states have copied the plan so that there are now seventeen states having full-time dental workers with the state department of health or of education. Some of these workers are dental hygienists, some are dentists, one is a registered nurse and one is a physical instructor. It was my good fortune to be the first full-time dental worker in Massachusetts and I am glad to have this opportunity to once again suggest to the dental hygienists in this state that we owe the dentists an immense debt of gratitude for their work, their patience, their understanding and tolerance. Mrs. McCarthy, the present worker, joins me, I know, in expressing sincere thanks to them.

I shall cite one example of the type of cooperation existing between the dental hygiene council and the state health department. Massachusetts was asked to present an exhibit and give a paper telling of the work in the state at the Los Angeles meeting of the American Dental Association. In order to make this possible, the expenses of sending the dental worker and of preparing and shipping an exhibit were shared by the council and the state. Fortunately, the Massachusetts exhibit took first prize, Minnesota taking second and California third. Such cooperation is not the exception but the rule in this state. Each of you in turn is cooperating with both of these groups so that the sum total is a program in Massachusetts on which many eyes are focused.

Having looked at "The Dental Hygienist: Here and There" from the geographic point of view, let us regard her "here and there" from the field of activities point of view. There is overlapping, for, in mentioning the activities geographically, the type of activity had to be stressed. May we reiterate some of the prominent fields for the dental hygienist: in industries, hospitals, state, municipal and private institutions, in public and private schools, in federal, state, county and municipal public health work, in training schools, on teaching staffs and in private offices.

Opinion is divided as to the value of the work of the dental hygienist; otherwise, every state would license her. What are some of the bases for opposing the hygienist? In talking with different men throughout the country, I have found that apathy, ignorance, personal prejudice and animosity, jealousy, an unfortunate personal experience with one hygienist, an unfavorable rumor or politics is apt to influence the individual. Politics, sectional feeling, school jealousies and apathy usually affect the group. There are, of course, some "conscientious objectors," but they will generally listen to reason, be willing to try the plan out, and be patient in the beginning, remembering that dentistry is still climbing up hill and often uphill motion is almost imperceptible.

Possibly all states are not ready for the dental hygienist at present. Her place in the public health field cannot be defined with any degree of authority by any one. Every one sees the hygienist movement in the light of his own experience, and no scientific research has been carried on which proves or disproves of how much value the hygienist is. Nor has any scientific experiment been carried on to prove of how much value the dentist is in a public health program. Statistics gathered here and there mean but little. As

some one has said, "Figures won't lie, but, unfortunately, liars will figure." I hope that some day a public spirited citizen in one of our cities—another Forsyth, Eastman or Rosenwald—will create a fund whereby a community program may be developed which will combine several of the types of program in vogue; for example, one school in which a dentist operates and the educational work is carried on by the teacher; another school in which all the educational work and followup are effected by the dental hygienist, referring the children to the family dentist, and still another school in which a dentist and hygienist work together.

Each of these suggestions, if elaborated on, would be a paper, so that they can merely be cited as types of individual programs which might be combined into a five-year community program. Sponsored by such a group as the American Child Health Association, with its research workers, the local educational, public health and dental groups, any city could develop a measuring rod for dental health work. Until some such plan is worked out, nobody can speak authoritatively. Do not misunderstand me: I am not belittling community and state programs. Indeed, I have the deepest respect for the work being carried on throughout the country. But I do feel that Pennsylvania, for instance, which uses the hygienist's services extensively, should not criticize Virginia, which does not employ the hygienist; and vice versa. Nor should Michigan, which employs the dental hygienist and nurse combination, try to solve the problem for Mississippi. It is only after a combination of methods has been worked out, supervised and evaluated scientifically that there will be a measuring rod to be put into the hands of health workers. Even then, the rod may be used full length in some communities and only a few inches be applied in others. Every state has its own problems, and the people in that state understand them and can solve them best. I was once at a dinner party in Alabama when a man from one of the middle western states said, with supercilious smugness, "Well, when I went to Boston, I thought I'd hear English as it should be spoken. But I couldn't understand the brogue of the first man I spoke to." Later, I went to that man's state, and I could not see the beauty in row after row, acre after acre, mile after mile of corn—all looking the same. It seems that we must get under the surface of things before we may hope to understand. We must feel the spirit. So the workers in the different states are the proper people to "feel" what their state needs.

Public health work has been stressed. There is one phase of office practice which seems extremely important to me and which is seldom stressed. One of the greatest assets in a professional practice is the children who come into it and help to build up the practice. It is a well known fact that many dentists do not care to work on children. Here, the hygienist may be of inestimable value, meeting the young child at regular intervals, teaching him how to care for his mouth, giving prophylactic treatments and accustoming him to think of the dentist and the dental office as part of the plan for health. Thus, dental operations will not be necessary for some time and, when they are, they will be natural and not unpleasant. In this way, the dentist's time and patience will be spared and his future practice protected. Recently, I have heard of several older men whose practices were falling off and who, after analyzing the situation, were honest enough to admit that it was be-

cause they would not work for children years ago.

Dr. Ray Lyman Wilbur, Secretary of the Interior, spoke before the Boston Chamber of Commerce last week on the high cost of medical care. He told of the committee which is making a five-year study of this problem and said, "If the medical profession doesn't find some answer to the high cost question some other group will." Dentistry faces the same problem as medicine in this respect. Perhaps the hygienist will be of value in helping solve the problem. Who knows?

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THE RELATIONSHIP OF THE PHYSICIAN TO THE DENTIST*

By JOEL T. BOONE,† M.D., Washington, D. C.

I HAVE been asked to address you on "The Relationship of the Physician to the Dentist," or I might entitle it, "The Relationship of the Dentist to the Physician." Ordinarily, an invitation to speak is not looked on as a pleasing compliment and is the sort of an invitation one attempts quickly to find an excuse for not accepting, but when the District of Columbia Dental Society issued such an invitation to me, I accepted happily, for I foresaw almost immediately an opportunity to render a service looking to better professional care of those human beings who come under our observation as patients, or such individuals who seek our professional advice.

This occasion affords me an opportunity to assist in welding the profession of medicine and the profession of dentistry into one composite and solidified professional group. Do not interpret this statement to mean that I am in favor of absorption of one profession by the other. Both professions are necessary to the public welfare; and one is dependent on the other. For years, these professions traveled on parallel lines, but fortunately for the physically abnormal, these lines have been converging in recent years. We of these professions must travel along the same route and as professional coworkers.

All medicine emanated from superstition, folk lore, mysticism, superstition and fanaticism. Even today, in this so-called enlightened age, we are not far removed from the day of those "isms." It is surprising to find individuals who are supposed to be enlightened yet practicing superstitious methods. Who in this room has not known supposedly intelligent people who carried horsechestnuts as a preventive against rheumatism, or held tobacco in the mouth to cure a toothache, or made a pilgrimage to watering resorts for the healing powers supposedly afforded? The curative power of color, particularly red, which was supposedly endowed with the greatest curative power, was important in folk medicine. Red neck bands, red abdominal bands,

*Read before the District of Columbia Dental Society, May 28, 1929.

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red pills, red lights and red flannel were all used to effect cures of various sorts. In a sense, the belief in its curative power is still held today by many. No branch of the healing art holds priority over the medical profession. The criticism of one branch by the other because of its origin or origins can be made only through ignorance of what has occurred in the other's developmental stages. The homeopath has been criticized because of his following of the teachings of Samuel Hahnemann, who instituted the medical law of *similia similibus curantur*. Hahnemann taught that likes cure likes; he championed the smallest dose that would effect a cure, and the single drug to combat a symptom complex. Today, while all his teachings are not followed, his great principle of treatment is practiced in modern medicine. Acquired antibody reaction is the result, to a large measure, of placing in the body a specific substance which stimulates a defensive mechanism by natural bodily function. Pollen desensitization rightly comes under the practice of minute specific drug or foreign protein reaction. Who has not practiced eclectic medicine even unconsciously? More widespread is the single drug practice coming into vogue. Why? Because it is rational therapeutics. Osteopathy, if not recognized as such, is applied in our every-day treatment. Physiotherapy was not regarded with favor as a scientific practice a few years ago, and yet today it is applied extensively as an adjunct to medical practice. Electrotherapy and ray treatments were ridiculed within our lifetime, and yet today we apply them in our practice. It is about time that cynicism and skepticism and ostracism in the practice of medicine be discontinued. The science of medicine is yet so undeveloped that, in our quest for enlightenment, we might find it in the most unexpected quarter. Let us as pilgrims of science not open the way for scorn or accusation. We want no charge against us, as Holy Writ relates, "There was no room for Him in the inn." It is time for us to investigate thoroughly, with tolerant and open minds, new theories of practice, accepting scientific advance irrespective of its origins. If we grant this, it will bring us to regard the development of medicine through her primitive swaddling clothes period as a part of her journey through the stars. We shall have learned the first essential lesson for physicians, namely, tolerance, which in turn furnishes equanimity, a priceless attribute of the medical mind. We cannot overstress the thought that the primitive people were in dead earnest in their medical beliefs. Dr. Oliver Wendell Holmes says:

> There is nothing that men will not do, there is nothing that they have not done to recover health and save their lives. They have submitted to be half drowned in water and half choked with gases, to be buried up to their chins in the earth, to be seared with hot irons like galley slaves, to be crimped with knives like codfish, to have needles thrust in their flesh, and bonfires kindled on their skin, to swallow all sorts of abominations, and to pay for all this as if to be singed and scalded were a privilege, as if blisters were a blessing and leeches a luxury. What more could be asked to prove their honesty and sincerity?

It is not an easy task to determine where primitive medicine ends and modern medicine begins. I repeat with all the emphasis that I command, let us be *tolerant*.

Dentistry, not many years ago, was regarded by the medical profession as mechanics and of a stratum unworthy to be placed on a parity with medicine. That day, I am happy to say, is past. The

sooner the two professions band together, the better it will be for our patients. We should work in the closest harmony and in the best spirit of cooperation, one relying on the other, with no consciousness of superiority one over the other.

Dentistry has made astounding strides. The United States was the first to recognize dentistry as a profession. Our country is far ahead of any other in dental practice. The dental profession is traveling at such a rapid pace that the other countries cannot hope to approach us.

As medical men we should be very proud of this fact, and it should give us an added reason for a more just recognition of the dental profession. Fuller recognition is sure to follow in the wake of progressive dental education. Basic education in medical science should be common to both medical and dental students; i. e., anatomy, physiology, histology, chemistry, etc. Dentistry was practiced in the early ages. It might have been practiced in the Garden of Eden. The first college of dental surgery was founded in Baltimore in 1839, the first class graduating two years later. This was the beginning of advanced dental science. Progress since has been continual and remarkable. The need of dental service in the United States Army and Navy was first urged on these military organizations about seventy years ago, in resolutions adopted and committees appointed to memorialize the Congress of the United States by action of the Western Dental Association at a meeting held in Quincy, Ill., in July, 1858, and by the action of the dental convention held at Cincinnati, Ohio, in August of that same year. A corps of dental officers was provided for the United States Army in 1901, but, to our shame, shortsightedness and stupidity, a corresponding corps was not available to the Navy until 1912. However, there was a dentist appointed in the Navy for duty at the Naval Academy in 1873 with the rank of acting assistant surgeon. He continued to perform his duties at the Academy for forty-four years. Today, the Army and Navy have as fine a group of dentists as you can find anywhere. I do not think on a whole that they rank second to any group. Sometime, unjustly, the civilian dentist shows an attitude of criticism, which for the most part is unfair and can be based only on ignorance and uncharitableness. No one recognizes more fully than the dental officer in the service his professional limitations, and he recognizes in certain individuals in civilian life his professional peers. An experience of fifteen years convinces me that the naval dentist (I am not quite so familiar with the Army Dental Corps, but feel sure it applies equally) has not so many peers in the civilian dental world as is ofttimes erroneously concluded.

In many respects, he (the Army or Navy dentist) is superior to the civilian dentist. Demands of the military service make obligatory elasticity and flexibility of mind. The many handicaps under which the dental officer works, the diversified forms of practice that he is called on to render, his life of daily contact with a variety of brother officers and with a cross-section of American youth such as is found in the enlisted branches, his enforced adjustability to military requirements, the military restrictions imposed on him, the spirit of cooperation in which he must daily labor, the freedom from enforced commercial practice—all these, I firmly believe, are factors which make him, considered as a composite individual, better rounded out than his brother in civil life. I say all these things advisedly with no reflection on the civilian; for the

latter contributes to the profession that which it would be impossible for the military man to acquire himself. As a matter of fact, in dentistry as in medicine, we in the armed forces must go to the civilian institutions and certain civilian practitioners and teachers for instruction and advice in many of the modern scientific advances. My comparisons are not invidious but are for the purpose of a more comprehensive understanding of what I shall say later on, on the subject of this paper, to wit, the relationship of the physician to the dentist, and vice versa. It is in the Army and in the Navy that that relationship is closest and to this fact the civilian profession can well look for helpful guidance. In the military service, the physician and the dentist are working hand in hand in the finest spirit of united effort and we are making scientific advances which can profitably be patterned after.

Dentistry should be regarded as a special branch of medicine and the dentist as a specialist who should be called into consultation as a routine procedure as is the roentgenologist, bacteriologist, urologist, pathologist, ophthalmologist, etc. Present-day medicine tends closely to cooperation with the dentist. The day has passed, I sincerely hope, when the dentist is on one side of the street and the physician is on the other, with their only contact through the medium of the patient. Close cooperation between the physician and the dentist is absolutely essential in the scientific treatment of disease. Perhaps the best example of cooperation between the dentist and the physician is shown by the fact that the only intelligent and fair way to practice medicine is to consider the oral cavity as one of the factors in the primary and secondary sources of general systemic pathologic conditions. Not only does the physician recognize the great importance of the mouth; but the patient also, in this enlightened age, recognizes that herein may be found the cause of his malady. Dentistry has been made the full equivalent of other specialties of medical practice. The practice of dentistry is a natural division of health service. Hospitals should be compelled to have dentists on their staffs. Dental service should occupy a position in dispensary service.

The physician, in his attempts to diagnose and subsequently treat disease conditions, fails to practice honestly and scientifically if he does not consider the oral cavity as the prime source of trouble in a long trend of symptoms and disease entities. To the dentist the physician therefore must resort for this special knowledge which the dentist possesses, regarding disease of the oral cavity.

Since Billings, Rosenow and their coworkers called attention to the oral conditions as a causative factor in disease, these conditions have assumed great importance in medicine. No physical examination is regarded as complete without a careful survey of the teeth and adjacent structures, which means gingivae, palate, buccal mucosa, lymphatic and salivary glands. This does not mean casual inspection, nor is it limited to roentgen rays, but it must include combining the clinical examination, vitality tests, transillumination, roentgen-ray and functional tests, and the interpretation of the abnormal findings whether they refer *per se* to a dental condition or to some local or general malady. Koplik's spots, precancerous areas, mucous patches, Vincent's infection, the characteristic tongue in scarlet fever, etc., must be recognized by the dentist. The information obtained from the dentist must be summarized and coordinated with facts gathered from the physical findings, laboratory data, gen-

eral roentgen-ray reports, etc. For this purpose, the patient's physician must be the coordinator and the clearing house for the knowledge gathered. He is responsible to the patient and he must make the interpretation and deductions as a result of consultation with his medical and dental colleagues. He, and he alone, is responsible. There must be a centralization of authority and responsibility. The dentist as well as other specialists must deal with the patient through the medium of the physician. Any other procedure results in confusion, misplaced confidence or lack of confidence, just criticism of indecision and disagreement on the part of the doctors, harmful delay in the application of treatment and unethical practices. The fact that the physician must coordinate the knowledge gained and advise the patient is in no way a recognition of the mental superiority of the physician over the dentist. The dentist may be more brilliant and most competent in the particular case at hand, but the physician—we will say the family physician—should present the facts and advise the patient as to the right course to pursue. I am positive that we have gone too far astray from the family doctor idea for the best interests of our patients. The old family doctor is one of the greatest institutions that civilization has ever produced. To the lay mind, he is the embodiment of the word "doctor." If we as doctors get too far away from the ideal physician, we are undermining the pedestal on which the ages have placed us in the eyes of civilization. It is the man or woman who sits by the beside of the physically and mentally distressed, who comforts the family in sorrow, who rejoices with them in their successes, who is councilor, advisor and friend, who is recognized by the family as their physician. Gentlemen, you get this relationship only in the visitation to the home; you cannot get it at an office. It comes only with intimate contact under diversified activities of the day and in the long vigil of the night.

The physician is derelict who ignores the importance of his dental colleague. He must not, in fairness to his patients, when they complain of some oral condition, show his disinterestedness in their general condition by referring them to the dentist for treatment or roentgen-ray examination and then forget them until the dentist has completed locally the treatment that he thinks necessary. Definite proof exists that teeth are an important factor in health. This fact at the outset infers that two individuals are responsible for the patient's teeth, the doctor and the dentist. They should therefore work in close harmony.

The span of life has been increasing for the last several decades owing principally to two factors: (1) reduction in infant mortality and (2) curbing of infectious disease. Longevity is not increasing at such a rapid pace at the present time, chiefly because we are not attacking with real success the degenerative diseases, particularly of the heart, blood vessels and the kidneys. It is not improbable that the detection and elimination of foci of infection before actual symptoms present themselves may tend, in some measure at least, to curb the degenerative diseases. In the campaign that we must wage, focal infection about the teeth will play a most important part.

Nature's blessing for a full complement of sound teeth was never appreciated by the public as it is today. No better evidence of this can be found than in the interest displayed by the public in general in the proper care of the teeth and the public recognition of the many ills that follow dental disease. In days gone

by, the individual presented himself to the dental practitioner for the purpose of seeking relief from pain or to have the necessary prosthetic care rendered. Today, in contradistinction to the past, an important portion of the practice of dental surgery comes from the medical practitioner who refers his patients for consultation with the view of obtaining an opinion on the relationship of the mouth to systemic disease or to enlist aid in the treatment of some condition. The dentist, as the advisor and important adjunct to the physician, has three principle functions to perform: 1. The preservation of sufficient grinding surface. 2. The elimination of focal infection. 3. Cosmetic appearance. The preservation of sufficient grinding surface is of decided importance to the physician as many gastro-intestinal disorders result from an insufficiency of the masticating surface. The dentist, therefore, is faced with the necessity of preserving, as far as possible, the existing teeth, and, furthermore, replacing lost teeth with proper prosthetic appliances which restore function. His second object, the elimination of focal infection, offers a tremendous field and one which has not been sufficiently tilled. Is the theory of focal infection overdone? There can be little doubt that some extremists are too radical on this subject, and further investigation will be necessary before we can tell with absolute accuracy when certain teeth should be removed. There must be a method found for the conservation of nature's dental supply. Of course, there will be less consideration of this factor necessary when dental aid is universally sought from early childhood on through life. Until that Utopian day is reached, we must find a means of treating abscesses without ruthless sacrifice of dental members. It is here that close cooperation between the dentist and the medical man is absolutely essential. The decision as to whether certain teeth should be removed should not rest alone with either one but should be the result of their combined judgment, if the best interests of the patient are to be served. When the public has accepted and insists on periodic physical examination, preventive dental practice will afford the dental profession its greatest opportunity for a humane professional contribution.

In the Army and Navy, we have an annual physical examination held by duly constituted boards, the membership of which is always comprised of at least one dentist. These physical examinations are increasing in importance yearly. The examinations, together with our entrance physical examinations of both officers and enlisted men, should be viewed as of the utmost importance, and the best medical and dental officers should constitute the examining boards. After the physical examination in the Navy, the boards hold a conference, where the findings are discussed, and then a joint report is drawn up stating the exact condition of the officer concerned. A copy of this report is given to the patient. Thus, you see how completely the Medical and Dental Corps of the Navy function together not only to their mutual advantage, but also to the benefit of the patient. In this union of the various specialties is born the "Siamese twins," preventive medicine and preventive dentistry.

I cannot attempt to go into the multitudinous phases of the benefits to be derived from the interrelation of the physician and the dentist, nor the need for joint consideration of oral and systemic disease. Nor shall I emphasize the importance of combined studies of these two professions in food-deficiency diseases; the interpretation of blood chem-

istry, salivary chemistry, etc., in their relation to disease originating in the oral cavity, and other interrelated conditions.

I would plead with you as members of the dental profession to endeavor most conscientiously to find ways and means of reducing the enormous expense associated with dental therapy. The medical and dental professions are criticized for the financial penalty that the public must pay for being ill. We as two health professions must solve this great problem. We can do it together much better than separately. A great deal of medical treatment, and dental treatment, probably even more so, is financially prohibitive to the average layman. This fact is of serious import in preventive dentistry. It is a common thing to hear people say, "I cannot afford to go to the dentist." The physician should view this attitude with alarm, for he knows full well the price that must be paid on the physical economy for this dental neglect.

Two thoughts in closing: The more intimate relation we have as dentist and physician with each other, the greater scientific progress we will make. Joint medical and dental meetings should be held more frequently. Participation of each in the other's meetings should be encouraged in every way. Close association should be maintained between national, state, county and local societies. Teaching institutions should have representation of physicians and dentists on each other's staffs. By an interchange of ideas, knowledge is more easily disseminated. Personal contact makes for a more cooperative spirit and a more enlightened practice.

I should feel very derelict and show a lack of faithfulness if, on such an occasion as this, I did not pay tribute to the service, to the courage, to the patriotism, and to the sacrifice of those dentists who served in the Army and Navy during the World War. It was my privilege to serve with members of the dental profession with the Army and the Marines in France as a battalion, a regimental surgeon and the assistant divisional surgeon of that division which had the greatest casuality list of all divisions in France—the Second American Division. Dental officers served under me in active combat operations. They were detailed in dressing stations as were physicians with fighting units. They acquitted themselves nobly. They wrote one of the most glorious pages in yet unchronicled history. Their deeds are little known except in the hearts of the men whose lives they saved and whose wounds they dressed. I could not attempt to narrate their deeds of valor nor call the roll of the deserving, but officers such as Cornelius H. Mack of the Naval Dental Corps performed innumerable acts of heroism while caring for the wounded on the battlefields. To the dental profession belongs the glory of having the first officer to fall mortally wounded of those who served with the United States Marines Corps forces in France — Weeden E. Osborne, Dental Corps, U. S. Navy, who, in attempting to rescue a fallen comrade on June 1, at Belleau Wood, was struck by a bursting enemy shell, and brought immortal fame to the dental profession in this supreme sacrifice. In war, the physician and dentist fought shoulder to shoulder; so in peace will they crusade together arm in arm in the cause of scientific medical progress, that their fellowmen may benefit by their united efforts.

SIGNIFICANCE OF THE BLOOD COUNT IN PERIODONTOCLASIA

By W. CLAUDE ADAMS, M.S., D.D.S., Portland, Ore.

IN my research work on the significance of the blood count in oral infections at Northwestern University Dental School in 1927 for the degree of master of science, I took as material 100 cases from my own practice, in which the hemoglobin, red, white, and differential blood counts had been made before and after treatment for pyorrhea and for the removal of other chronic oral infection, and in many instances of which infections of a chronic character were present in other parts of the body. The conclusions reached as a result of my study were as follows:

1. With the removal of chronic oral infections, some improvement in the blood of patients with systemic infections of a chronic character not attributable to foci in other parts of the body can be expected in practically all cases.

2. This improvement is not to be found in all types of blood counts in all cases; but more than half (58 per cent) show improvement in at least four different types, and more than three-fourths (77 per cent) in three out of six types. Ten cases show improvement in all six types of cell counts studied, namely, hemoglobin, red, white, polymorphonuclear, large and small lymphocyte counts.

3. The improvement judged on clinical grounds parallels improvement judged by blood counts in more than three-fourths (77 per cent) of the cases.

This material is accessible in my thesis which was published in an abridged form[1].

I herewith submit reports of four cases included in the 100 cases employed in my research, in all four cases of which the blood picture showed an improvement in all types of blood cell counts, and in which the improvement in the blood was consistent with the physical change in the patients. All of the four patients in this report had pyorrhea and other forms of oral infection. The improvement in their physical condition after treatment was phenomenal, and the improvement in the blood picture was unusual, in that every type of cell count was nearer normal after than before treatment.

REPORT OF CASES

CASE 1.—A man, aged 50, who had valvular heart trouble, high blood pressure and suspected cholecystitis, had been in bed for six weeks, and had been given but two days to live, unless he submitted to an operation for gallstones. He had been refused life insurance by two companies. After the pyorrhea was treated, four badly infected teeth were extracted, and the left antrum of Highmore was drained and treated, he improved to such a degree that, soon after, he was told by the examining physicians of the same insurance companies that he might have

* Read before the American Academy of Periodontology, Minneapolis, Minn., Aug. 17, 1928.

1. Adams, W. C.: Dent. Cosmos, 70:314 (March) 1928.

all the insurance he wished. Following are the blood counts before and after treatment: red blood cells: before, 4,272,000; after, 5,212,000; white cells: 12,250, 8,180; hemoglobin: 85 per cent, 100 per cent; polymorphonuclears: 54 per cent (6,615), 58 per cent (4,744); large lymphocytes: 13 per cent (1,592), 4 per cent (327); small lymphocytes: 26 per cent (3,185); 33 per cent (2,699).

CASE 2.—A woman, aged 30, had been ill for several years. She was anemic, 25 pounds under weight and very weak, and had suspected tuberculosis. There was a general pyorrheal condition with pockets ranging from 5 to 8.5 mm. in depth. The pyorrhea was treated and one pulpless tooth was extracted, after which the patient regained her health and her normal weight. The blood counts before and after treatment were: red blood cells: 4,200,000, 4,800,000; white cells: 5,600, 8,000; hemoglobin: 70 per cent, 85 per cent; polymorphonuclears: 55 per cent (3,080), 70 per cent (5,600); large lymphocytes: 15 per cent (840), 5 per cent (400); small lymphocytes: 24 per cent (1,344), 25 per cent (2,000).

CASE 3.—A woman, aged 40, had had rheumatism in the knee for seventeen years, and used a cane in walking. She had been in a sanitarium under treatment for nerve exhaustion and heart trouble. Rheumatism developed in her hands, and the physician referred her for oral examination and treatment. Pyorrhea pockets varied in depth from 3 to 9 mm. Pyorrhea treatment, the extraction of three pulpless teeth and curettage of residual areas resulted in the patient's ultimate recovery. She was soon able to resume her work as a teacher. A rabbit inoculated with a culture of green-producing nonhemolytic long chain streptococci from the tooth root developed the same symptoms that the patient had. The blood count before and after treatment was as follows: red blood cells: 5,840,000, 5,000,000; white cells: 11,900, 8,000; hemoglobin: 85 per cent, 88 per cent; polymorphonuclears: 61 per cent (7,259), 65 per cent (5,200); large lymphocytes: 10 per cent (1,190), 6 per cent (480); small lymphocytes: 15 per cent (1,785), 24 per cent (1,920).

CASE 4.—A man, aged 68, had muscular rheumatism of long standing, neuritis and a blood pressure of 200. He had been treated for antrum trouble by specialists for more than a year without obtaining relief. Roentgenograms revealed antrum involvement and apical abscesses. Pyorrhea pockets ranged from 4 to 10 mm. in depth. Pus from an abscessed upper right first molar was discharging into the antrum. After the tooth was extracted and an antrum operation was performed, the pyorrhea condition was then taken care of. For the first time in months, the patient was free from pain from the antrum. The blood pressure returned to normal, and his health improved in a marked degree. He is now 77, is hale and hearty and leads an active life. When tooth cultures were made and a rabbit was inoculated, the rabbit went lame. The blood counts were: red cells: 4,284,000, 5,440,000; white cells: 4,650, 8,250; hemoglobin: 90 per cent, 100 per cent; polymorphonuclears: 74 per cent (3,441), 63 per cent (5,197); large lymphocytes: 2 per cent (93), 2 per cent (165); small lymphocytes: 22 per cent (1,023), 33 per cent (2,722).

701 Selling Building.

ADVANTAGES OF A RIGID FILM TECHNIC IN DENTAL ROENTGENOGRAPHY*

By JAMES A. BLUE, D.D.S., F.A.C.D., Birmingham, Ala.

WE are living in an age when we must know. Guessing is no longer tolerated in any line of endeavor. Research is being conducted in all branches of science. The day has passed when the physician contents himself with a good look at the patient's tongue and a check of his pulse rate. The physician of today conducts a complete physical examination, including a thorough checkup of the teeth, and all osseous structures, as well as the soft tissues of the mouth, and it is here that the dentist may play an important part, cooperating in the examination and contributing to its success.

The physician is not supposed to know a great deal about the structures of the mouth: he has not had the necessary training to make him proficient in the diagnosis of mouth infections. Therefore, he is badly in need of intelligent assistance from the dentist. In addition to a set of full mouth roentgenograms which show clear detail, a report of the findings together with advice as to what needs to be done should be furnished him. There are many patients who consult us regarding the condition of their mouths, with relation to ailments in other organs of the body. We should be able to render an intelligent opinion. It is impossible to do this with slipshod and indifferent roentgen-ray work.

Pictures are being made today that are worse than no pictures at all, as they mislead both patient and operator. The patients think that the work has been done as it should be, and it is a difficult matter to convince them that it is of no value in the diagnosis, and should be done all over again. Even if they apparently think that we merely want an extra fee, we should not hesitate to offer and insist on a better service.

About six years ago, as we were dissatisfied with the distortion of the image which appeared on films, especially those used in the cuspid regions, we decided to try a method which would prevent the film bending. This was accomplished by using a metal backing of 26 gage German silver plate. A plain piece was cut to fit the regular Eastman films, as they are made with flanged margins, but it was necessary to make a backing with a small flange at each end to fit Bucks and Eastman "radia-tized" films. It was found that a narrow film was needed for constricted and V-shaped arches, and by cutting away one fourth of the regular film and binding the cut edge with passe partout binding tape, to prevent the ingress of light, we are able to obtain the desired results. These films should of course, be prepared in the dark room to prevent exposure to light.

*Read before the Section on Radiology at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1929.

An incorrect position of the tube or head is the cause of many exposure faults, in that it lengthens or foreshortens or overlaps the image. The head should be placed in such position that the occlusal surfaces of the teeth are on a horizontal plane. This technic is advocated by Simpson, who suggests a specially designed spirits level to assure the proper position. I prefer this technic for all teeth in the maxilla and the mandibular molars. For the exposure of mandibular bicuspids and the six anterior teeth, the head is tipped backward so that the mandible is slightly raised.

In exposing the maxilla, if the tube is placed too low, elongation of the image will be the result, and the apices of the roots may be projected entirely out of the picture. If the tube is too high, with the cone too low, the result is a foreshortening, spoiling the image of the periodontal structures. If the rays are not directed in such a manner that they will pass through the interdental spaces, there will be an overlapping of the image, making it impossible to diagnose small interproximal cavities, as has been stressed by Raper, and is essential in dental roentgenography.

After the patient has been comfortably seated in the chair, and the mouth carefully surveyed for abnormalities, such as osseous enlargements, fistulas and evidence of periodontal lesions, instructions should be given the patient regarding the method of holding the films in place. Demonstrate with the thumb in the patient's mouth, exerting the amount of pressure required to hold the films firmly in contact with the tissues. We use the upper left molar region for a starting point in making full-mouth examinations. A large cotton roll about the length of the film is placed on the palatal surfaces of the first, second and third molars, and the film is placed against the cotton roll. The patient is then instructed to hold the film in position with the thumb of the right hand and the thumb should be guided to place by the operator, the cotton roll serving to hold the film more at a perpendicular angle than would be the case should the roll not be used. This aids greatly in eliminating the malar shadows. In most cases, the tube may be lowered sufficiently to permit the projection of the rays under the molar structures.

An effort is made to show the three molars together with the tuberosity on this film. The next film is placed in position to include the distal half of the cuspid, both bicuspids and the first molar, the cotton roll being used as described above. The tube should be raised for this exposure, but it should not be so high that foreshortening will result. The rays should project through the interdental spaces of the bicuspids. A narrow film is used for the next exposure, the film being placed perpendicularly, paralleling the cuspid, with the cotton roll in position, and balanced in such a manner that the lateral incisor, cuspid and first bicuspid are shown on it with their contacts. The rays are projected through the cuspid. A narrow film is also used for the exposure of the central incisors, the cotton roll being placed as described and the rays projected through the median line. In broad arches, a regular film may be used for this exposure. The same technic is applied to the right side, except that the patient's left thumb is used to hold the films.

The technic for making films of the mandible differs only slightly from that employed for films of the maxilla. The cotton roll is not used in the molar region. The forefinger is employed to hold the films in position. In some cases,

it is advisable to use a holder in the molar region, as the film is not so likely to be displaced by the muscles of the tongue. Many patients draw the tongue backward and upward when the mouth is opened, owing mostly to nervousness. When this is noticed, assurance should be given that there is no danger or pain connected with the procedure, only a slight discomfort due to the pressure of the films on the tissues of the mouth, and the patient should be instructed to relax. The tongue should not be mentioned. Request the patient to breathe through the mouth, as this procedure tends to relax the muscles and prevents heaving. This suggestion is very helpful when the films are placed in contact with the soft palate.

Many pictures are spoiled in the dark room. If there is evidence of fogging, the dark room should be examined for light leaks. The ruby light may be unsafe. A test is made by exposing an unwrapped film for five minutes. A coin may be held on the side nearest the lamp. Some time ago, we were troubled with fogging of the films. One set would go through perfectly, while another would be spoiled. In some cases, only the pictures on one set of clips would show evidence of fogging, while the others were clear. After a thorough search, we found that the brushes of the ventilator fan were sparking in such manner that considerable light was produced, and when this was corrected, we had no further trouble of this nature. A fresh solution, kept at 68 degrees during the time of development, should be used at all times.

APROPOS THE YOUNG SPECIALIST

By C. L. RION, D.D.S., Seattle, Wash.

I HAVE just read the following extract from *The Journal of American Medical Association:*

One of the besetting sins of the present age is hurry, and if a man specializes too early he is apt to cultivate his own department to the neglect of others.

An exclusive interest of this kind leads to narrow and distorted views whereby the part is magnified out of all true proportion to the whole, while concentration of thought along a single line interferes in many cases with the ability to take a comprehensive view of the whole morbid process. The "young man in a hurry" who thinks he knows all about his special subject runs a great risk of being a danger both to himself and to the community in which he practices. His enthusiasm, so praiseworthy in itself, stands in need of direction and can lead only to disaster if permitted to have full scope within the narrow and cramping boundaries of his specialty. It follows, therefore, that although the specialist may devise some new form of local treatment, or improve methods of operative technic, there is a risk of his doing so without regard to the broad principles which underlie all rational therapeutics.

Would that this truth could be more firmly impressed on the young graduate of today. In this age of rapid transit and great hurry to get somewhere, the young graduate does not have the patience to gain the broad knowledge of his profession which can come only by

years of actual practice, and which he most certainly does not get during his term in college. I am reminded of the logic of the wise Chinaman. He was a wealthy diplomat visiting in this country. His host was continually giving instructions to his chauffeur to take short cuts across town. When the journey was completed, the American host said to the wise Chinaman, "Now we have gained two minutes by making those short cuts." The Chinaman said, "Yes, and now what are we going to do with the two minutes?"

There have been many times during the fourteen years that I have been specializing when had it not been for the broad knowledge gained from a former fourteen years of general practice, I should have been at a loss to form the proper opinions or to determine the course of treatment to follow in certain cases, and should not have been able to cooperate intelligently with the general practitioner referring patients to me.

There is no question that the specialist becomes somewhat narrow in his views of matters pertaining to our profession. I have had the good fortune to be a member of the state board of dental examiners in this state for the past five years, and it has been like a postgraduate course to me. A board member must be posted on all subjects in our curriculum, and this requisite certainly does keep one in better touch with the view of the general practitioner; which is right and proper. Naturally, the specialist is expected to be more proficient in his particular specialty than the general practitioner, and he must of necessity concentrate more closely upon it, but "it is well to have done this thing, but not to have left the other undone."

This subject has been strongly impressed on me by an experience in my own office the past year. A young graduate passed the board examination here and opened his office in the most modern building in the city. After three or four months of waiting for the patients who did not come, he became restless and impatient, and decided that the big money was in a specialty, so he cast around him to see what would be most remunerative. He decided on exodontia and anesthesia. He came to me and stated what was on his mind. I told him he was too young, and too inexperienced, that the public lacked confidence in youth in specialty practice. This did not deter him. I did my best to make him understand that several years of general practice were needed, to acquire not only a good general knowledge of his profession, but also that sense of delicate touch that is so essential to the expert surgeon. He was not convinced, and insisted that he wished to become associated with me. Knowing well what the result would be, I told him to come and try it out for six months before he bought an interest anywhere. In four months, the general public and the general practitioner had convinced him most thoroughly, and he returned to general practice. I believe that was the most valuable four months of that man's career.

It is nothing short of criminal for a young graduate to attempt to administer anesthetics without several years of experience, preferably under the guiding hand of an older man. I have made an intensive study of anesthetics for twenty-nine years, and I learn something every time I administer one.

The young graduate cannot expect to have the ability to judge his patient quickly as to type and temperament, make heart examinations and in other ways size up his patient as to risk. In twenty-nine years, there have been two

deaths in my office, one a year ago and one four years ago, neither of which was due to an anesthetic because none was administered; but in the office of a less experienced operator, both patients would undoubtedly have died under an anesthetic because the young man would not have recognized the condition of the patients when they came in. The first case was that of a young woman who came in for a tonsil and frontal sinus operation by an eye, ear, nose and throat specialist. The nasal passages were packed with 4 per cent cocain and epinephrin. As the condition of the patient was not what I should term satisfactory, she was allowed to sit down and wait for a while. In about two minutes she was dead. Postmorten examination revealed an enlarged thymus gland. The cocain was fatal in the condition of status lymphaticus. I never use cocain.

The second patient, who was brought in by a dentist, was in a state of collapse when he came in. Ludwig's angina, following an extraction at another office, was manifest at the outset. The jaws were locked and the temperature was 103.5. This was no case for a young graduate. I recognized at once that it was a hospital case and an urgent one. The patient was placed on a bed and given pure oxygen in an attempt to resuscitate him for the trip to the hospital. He rapidly grew worse, showing every evidence of obstruction of the air passages. As oxygen did but little good, the city fire department was asked to bring the inhalator, which is similar to a pulmotor. They arrived in five minutes. By then, it looked as if the patient were past hope. They revived him, however, and for an hour it seemed that he would recover. Suddenly, he died. Postmortem revealed double pneumonia, two very large abscessed tonsils, Ludwig's angina, and an internal goiter. No anesthetic had been administered. What would the young graduate have done with this case?

I repeat: No young graduate should specialize until he has had at least five years of general practice, and preferably ten.

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Editorials

THE STRUGGLE UP

Ever since honest men began treading on the toes of the promoters of spurious products and raising a question as to the procedures that were being used in the accumulation of wealth at the expense of the public welfare, there has been a constant struggle. On the one hand, there has been an effort to let in the light on the methods and practices of those who were exploiting the people for unworthy purposes, and, on the other, just as determined an effort to keep those methods in the dark. Vast amounts of money have been expended by "the interests" in the suppression of facts, and the greatest ingenuity has been employed to render null and void any attempt to enlighten the public on the nature of many of the products that were being recommended for use either as medicines or as foods. Large fortunes have been built up by foisting worthless or harmful materials on the people, and the moment any attempt has been made to expose the nature of these materials or the methods

used in marketing them, it has been met by the most determined opposition.

Even the power of the press was invoked to aid in furthering the interests of the promoters. The promotion of "patent" medicines and food adulteration were the outstanding methods of imposing on the people, and when, in 1902, the first attempt was made to legislate for the protection of the public in the form of a pure food bill, the forces for "the interests" lined up against it, and threatened the newspapers with a loss of advertising patronage if they supported the bill or published anything derogatory to the enterprises which the pure food bill threatened. At that time, a large source of revenue came to the newspapers from patent medicine advertisements, and this was a powerful lever to use on the press. In some of the advertising contracts, a clause was inserted providing for a cancellation of the contract in case there was any legislation passed in that state inimicable to the patent medicine interests.

It was only when the flood light of publicity was turned on the subject that suitable legislation was passed for the protection of the people, and this legislation was obtained only after a struggle that lasted for years. Even yet it requires constant vigilance to prevent abuses of the most flagrant type. The Government is bearing down harder and harder on the evil of misbranding, and for a long time the American Medical Association has conducted a research laboratory for the purpose of investigating remedies that are being offered to the public. Within the past year, the American Dental Association has employed a chemist, who works in the A.M.A. laboratory through the courtesy of that organization, testing the various products on the market in the way of mouth washes, tooth pastes, pyorrhea cures or other dental remedies that are being advertised to the profession or the public.

One of the greatest evils in connection with the traffic in proprietary remedies is the secret nature of many of the advertised products. No professional man has the right to prescribe or recommend any preparation the ingredients of which he does not know, and, for his own protection, he should demand that this informa-

tion be forthcoming before he uses any product. He would be placed at a distinct disadvantage in a malpractice suit if it were brought out that he was using a remedy on a patient without knowing the ingredients. No honest manufacturer will ask a professional man to use a secret remedy, and no honest professional man will use it even if he is asked.

Probably the greatest farce connected with the advertising of proprietary remedies has been the liberal use of published testimonials. The extent to which this practice has been carried is not only misleading to the public but is a reflection on the intelligence of the professions as well. In some instances, there is no question that testimonials have been given by men with honest intent and without a thought of possible harm; but, in too many cases, they are the result of ulterior influences and thus they become a real menace. The statements made in these testimonials are usually inaccurate in the extreme, and they serve no useful purpose, but tend only to lead the readers astray. One of the most striking examples not only of the inaccuracy but also of the utter absurdity of some of these testimonials is recorded where, in the same issue of a newspaper, there appeared a strong testimonial of a patent medicine by a man who claimed that he had been greatly benefited by its use, and in another column a notice of this man's funeral. Thus, while one statement proclaimed that the man was marvelously improved in health, the other said that he was dead and buried. The manifest assumption is that the advertising man and the news editor failed to do good teamwork.

What a farce this sort of thing is! There is, of course, on the part of all generously minded men a worthy disposition to help others by a word of encouragement, and this is the basis of certain testimonials, but the abuse to which testimonial writing has been brought has developed such a sentiment against the practice that today no self-respecting man will be induced to sign his name to an endorsement of any product, good or bad.

The work being done in the Bureau of Chemistry of the American Dental Association, and reported in THE JOURNAL, is creating much favorable comment, and, in this connection, it

should be said that the ultimate aim of the bureau is to do some constructive work in the way of suggesting reliable drugs and trustworthy products. To this fortunate day, we are all looking with much anticipation; but before a stable foundation can be laid for such work, it will be necessary to clear away the weeds and thistles. This is the present aim of the bureau; the idea being not to injure any worthy or reliable manufacturer, but merely to sift the bad from the good and let the good remain. In all of this, there is more or less struggle; but let us confidently hope that it is a struggle upward.

FURNISHING DISTORTED FACTS TO THE PUBLIC ABOUT DENTISTRY

The power of the "movie" is growing greater every day. As an educational factor, it is becoming more and more important, and its influence for good cannot be computed if it is directed along the proper channels. Conversely, it can do much harm if it is turned to unworthy purposes, and therefore the directors should exercise care in the productions that they sanction.

A recent picture (a "talkie") is a case in point. It is supposed to be a comedy showing a certain Dr. Payne, a dentist, extracting teeth. Moans and shouting of patients are heard, and to make it more realistic (?), the dentist gets up on the patient's chest and rolls over on the floor with the patient, all the while holding on to a tooth.

This may bring laughter from the audience, which we suppose is the object of such a distortion of facts, but a dentist treating a patient in any such manner would be guilty of inhuman butchery, and could be held for malpractice. We are sure that the producers never dreamed of the possible harm such a picture could do. Imagine children in that audience who some time later might need attention to the teeth. While the child might laugh at the antics shown in the picture, there is one thing very sure: the next time he approached the dental chair, he would have a vivid recollection of that dentist maltreating a patient.

It is nothing short of criminal to add to the fear of children in any procedure that must of necessity come into their lives sooner or later, and when we consider the very serious efforts that have been made by the members of our profession to break down the dread of children, and think of the success that has attended these efforts, it is disheartening to have an influence such as the moving picture employed to undo all the benefit that has been gained by years of patient endeavor on the part of the profession.

The complaint of this picture was mailed to the editorial office by C. O. Miller, chairman of the Public Health Committee of the Harrisburg Dental Study Club, and C. J. Hollister, chairman of the Mouth Hygiene and Public Health Dental Education Committee of the Pennsylvania State Dental Society. These men are in a position to realize the far-reaching damage that may be done by such a picture, and we are very sure that they will have the endorsement of the entire profession in registering their objection to it.

It is not at all likely that the producers of this talkie had the slightest idea of doing harm or working injustice. The moving picture promoters are exerting every effort to elevate their calling, and they have already eliminated many objectionable features from their productions. It only remains to be shown that a very respectable element of the public holds a critical attitude toward a certain feature of their work to have that feature brought under censorship at once, and we are very sure that when their attention is called to the possible evils of this picture, it will be discontinued.

In round numbers, there are between sixty and seventy thousand dentists in this country, and it is safe to state that not one of this number could be found who would sanction this picture. It is so inimical to the best interests of the profession, and to the welfare of children, that no argument is required to prove its baneful effects, and this fact should be brought to the attention of the promoters, to the end that it be discontinued. A picture that has so little of truth to recommend it should never appeal to the producers, even apart from the injury that it may do to children. And this injury is sufficient in itself to condemn the production.

THE WASHINGTON MEETING

As the time approaches for the Washington Session, the promise is growing greater for an outstanding meeting. Reference to the program in this issue will disclose the fact that a great deal of effort has been expended in its preparation, and it merely remains for a bumper attendance to break the record for a successful meeting.

Washington is always attractive, and every citizen of the United States should make a pilgrimage there as often as possible. There are many in the profession who have never been to Washington, and this is an unusual opportunity to visit it under the most favorable auspices and at a minimum of expense.

The Committee on Local Arrangements have been working very hard in preparation for this meeting and the profession should show its appreciation by attending in large numbers.

If you have not made your hotel reservations, it would be well to attend to it at once. Always at our meetings there are a certain number of members who come in at the last moment without having made reservations, and the Local Committee are put to their wits' end to try to obtain accommodations for them. It is not fair to the Committee or to the hotels for members to come without reservations at a time when so many visitors are in the city. Even if accommodations are ultimately found, it is only at the expense of much needless energy, and inconvenience to men who are already greatly overworked, and who should not be subjected to this injustice. A little foresight on the part of our members will not only aid the Local Committee but will also save much confusion at the time of the meeting.

BUREAU OF CHEMISTRY

A PYORRHEA-CURE FRAUD

The Postal Authorities Close the Mails to Dr. Cheek's Laboratories*

FOR some years there has been advertised an alleged cure for pyorrhea, purporting to be the discovery of Dr. J. H. Cheek, "the Famous Pyorrhea Specialist." The postal authorities on July 8, 1929, issued a fraud-order closing the mails to the Dr. Cheek's Laboratories, J. H. Cheek, D.D.S., president, and various other trade names used by the concern. According to the memorandum of the Solicitor of the Post Office Department to the Postmaster-General recommending the issuance of a fraud-order, it appears that the business was first started in St. Louis, Mo., about seven years ago by J. H. Cheek, M. C. Binford and Charles Thornton. Later, it was incorporated, the officers being J. H. Cheek, president; Emma Heinritz, vice president, and George W. Brendel, secretary and treasurer. Capital stock was issued to the amount of $10,000, the majority of which is held by Brendel. Charles Thornton has had no connection with the business since its incorporation. J. H. Cheek, who is a dentist located in Terre Haute, Ind., is also said to have withdrawn from active participation in the business, but permits the use of his name by the present operators, consisting of Mr. Brendel and his sister. Brendel himself is a printer by trade.

The alleged treatment consisted, essentially, of a mouth wash, although there were accessories, such as a tooth paste, a "tartar remover," and some laxative tablets. The mouth wash was, apparently, typical of its class, containing alcohol, glycerine, cresol, zinc chloride and the usual flavoring — thymol, eucalyptus, spearmint, etc.—colored with carmine and cudbear, and sweetened with saccharine.

While the "treatment" purported to come from "Dr. Cheek's Laboratories," which the letterheads described as "manufacturing chemists," there were no laboratories nor manufacturing chemists. The equipment was essentially that of the usual mail-order office. The products sold were purchased from a local drug house.

The advertising literature put out by these people abounded with references to "Dr. Cheek," without the suffix "D.D.S." or the word "dentist." Symptom blanks and report forms were used, and according to the admission of George W. Brendel, who ran the thing, the intent was to give the impression that the statements filled in by purchasers of the "treatment" would be given attention by a physician, and that the business was

*Reprinted from the Bureau of Investigation, The Journal of the American Medical Association, Aug. 10, 1929.

directed by a physician. The facts were that the "doctor" referred to in this Missouri concern's advertising was a dentist who was located in Indiana and gave the so-called symptom blanks no attention whatever, all the correspondence being handled by printer Brendel and his sister, neither of whom had any dental or medical training.

The government, in its case against this concern, brought out the fact that the so-called pyorrhea cure would not cure pyorrhea, remove pus pockets or restore loose teeth, as claimed; it would not cure cases which had been found to be incurable, as was also claimed, and the "treatment" did not contain the "twelve most effective specifics known to medical science." As a result, Solicitor Horace J. Donnelly, in his Memorandum to the Postmaster-General, recommended the issuance of a fraud-order against the Dr. Cheek's Laboratories and Dr. J. H. Cheek, president. The order went into effect July 12.

BUREAU OF DENTAL HEALTH EDUCATION

HABITS WHICH CAUSE IRREGULARITY OF TEETH*

By HARRIS W. McCLAIN, D.D.S., Chicago, Ill.

A HABIT is something which we have learned to do without giving conscious thought to it. Probably from 80 to 90 per cent of the acts daily performed by any individual are habits. Walking, talking, eating, writing and hundreds of other things that we do without thinking of the manner in which we do them are habits. We have done these things so often, in the same way, under the same circumstances, that they are automatic.

What a complicated life each one of us would lead and how little we would accomplish if we had to stop and think of each little thing we do each day.

A child learning to walk must think of each step. In learning to feed himself, he must weigh carefully each movement in order to carry food to his mouth.

Habits are formed in many ways and are dependent on many conditions, and quite often one habit depends on another. Some of our habits are formed by consciously doing the same thing over and over. This is training, and playing the piano is an example. Other habits are acquired without conscious effort on our part. We just start doing a thing in a certain way and it becomes a habit. Right handed persons usually put on the left glove first, and a man will carry his pen, his keys or his handkerchief in the same pocket every day and take them out, use them and put them back without knowing it. In childhood, many of our habits are formed from imitating others.

Surveys which have been made in many parts of the country indicate that from 50 to 70 per cent of the children in the grade schools have irregular or crooked teeth. This means that nearly three-fourths of our school children have deformed jaws, for these irregular teeth are symptoms of a deformity of the jaws. Much of this trouble we believe is not necessary, for, in many cases, crooked teeth are caused by improper habits.

It is believed by a great many dentists who have studied this problem that few if any of these cases are inherited, for it is the tendency in nature to reproduce perfect forms and to restrict the reproduction of imperfect ones.

Deformed jaws and the irregular teeth that go with them are acquired, in most cases, during the life of the individual, and they usually become quite noticeable about the time that the baby teeth are being replaced by the permanent ones, or between the sixth and twelfth years. This is usually the most favorable time to treat them, if treatment is needed.

*A radio talk broadcast, March 19, 1929, over WBBM, Chicago, Ill.

The baby teeth are usually quite regular, but there are a great many, perhaps a majority, of cases in which the baby jaws fail to develop, and children with very even baby teeth frequently have crooked permanent teeth.

The teeth grow into two rounded arches or sets, upper and lower. They are molded into form or guided into place by the proper action of the tongue on their inner side and the lips and cheeks on the outside. The proper use of the lips, cheeks and tongue, as well as the teeth, in chewing, causes the jaws to grow normally and to make room for the permanent teeth to come in straight.

If the action of the tongue, which assists the forward and outward growth of the teeth, is balanced by the action of the lips and cheeks, which limits the outward growth, we can expect a perfect set of teeth as a result. If this balance is disturbed, or some other type of interference takes place, an irregularity in proportion to the disturbance may be expected.

Among the things which contribute to the growth of the jaws, perhaps the most important is the pressure exerted by the permanent teeth as they grow within the jaws and come up through the gums to replace and take their places behind the baby teeth. If the baby teeth are shed too early, or if cavities in the baby teeth are not promptly and properly filled, this growing force may be lost.

The sixth teeth from the center line are the first permanent molars. They are permanent teeth and the most important ones in the mouth. They should be watched for and not allowed to decay, as they are not replaced when lost.

There are a number of habits which we believe cause deformity of the jaws and crookedness of the teeth. They are improper habits of eating, breathing, resting and sleeping. Nervous habits also contribute their share in this problem.

There are two general classes of these habits: (1) habits which disturb the balance between the lips and cheeks on the outside and the tongue on the inside of the teeth; (2) pressure habits which deform the jaws by pushing it out of shape and by pushing the teeth out of their proper places. Mouth breathing, lip biting, lip sucking, cheek biting, tongue biting are in the first class. In the pressure group, we find thumb sucking, the use of pacifiers, leaning and pillowing habits.

When a child breathes through the mouth instead of the nose, the tongue is held in the bottom of the mouth, is not active and does not exert proper outward pressure, and the jaws are therefore too narrow. The upper lip does not develop properly and the upper front teeth move forward. The lower lip rests between the upper and lower front teeth.

In lip biters, the upper front teeth are also pushed outward and have spaces between them, while the lower front teeth are pushed backward or caused to bunch or overlap each other. Lip biting and lip sucking often cause the lower lip to become thick and ugly.

The teeth are prevented from growing to their full length by the habit of tongue biting, and a condition we call open bite is caused. The upper and lower teeth cannot meet; sometimes in front and sometimes on the sides. Open bite in the back teeth and some other deformities are caused by cheek biting in some cases.

If a child, with elbows resting upon a table or desk or a chair arm, leans the face upon the hands, as many children do, the pressure may cause the upper or lower teeth to be pushed inward. In the same way, the lower jaw may be

pushed to one side or backward or forward. If the hand is placed under the chin, the lower jaw may be pushed upward and backward, a closed bite resulting. Similar types of deformed jaws and irregular teeth are caused by pressure from sleeping with the hands or arms under the face or even under the pillow or by using high or hard pillows. Most children who sleep on the stomach have pillowing habits.

Of course, there are other things besides habits which cause crooked teeth, and habits do not always cause permanent deformities. These habits are usually formed very early and are easily broken if discovered, if the beginning is made during early childhood. This is a matter of training, and I would advise mothers of young children to supervise the child's habits of eating, resting and sleeping with these things in mind, and would suggest a few things that may be helpful:

Nursing.—If possible, every baby should be breast fed, not only because mother's milk is its natural food, but because the exercise for his jaws and tongue which nursing provides is not received in bottle feeding. Bottle babies sometimes develop nipple habits which deform the jaws and breathing spaces. Of course, no well informed mother will allow her baby to have a pacifier.

Eating.—Give the child hard things such as zwieback to bite on even before he has any teeth. As soon as he has some of his back teeth above and below, begin giving him such hard foods as your physician may suggest and teach him to chew with his lips closed and on either side of his mouth. Teach him as early as possible to swallow with the teeth closed. Do not put all of his food through a sieve or collander. His teeth are there for the purpose of grinding food and to prepare it for the rest of the digestive processes. If he does not learn how to use his teeth early, he may pay for it later with digestive disturbances and he will not get the exercise which is necessary to make his jaws grow.

Resting.—Teach the child to sit upright in his chair with both feet on the floor. If he is reading or writing at a table or desk, he should not support his head upon his hands. Children should be taught to keep their hands away from their faces and especially out of their mouths. Slovenly resting, reading and studying habits lead to defects in posture which deform other parts of the body as well as the jaws.

Sleeping.—The natural sleeping position is on the back. While infants should be turned at intervals, they need never be so placed that pressure is exerted on the face. They should be placed on the side and back as a relief from the flat back position, but never on the side and stomach or flat on the stomach. Dolls, stuffed animals and toys should be removed from the bed after the child is asleep. Remember that the baby's jaws like all other bones are soft and pliable and that in addition they contain at birth the crowns and germs of fifty-two teeth and that any habit which has a tendency to deform these jaws will be quite likely to cause the child to have crooked teeth.

WHY IRREGULAR TEETH SHOULD BE STRAIGHTENED*

By F. E. HABERLE, D.D.S., Chicago, Ill.

NO doubt all of you have noticed individuals wearing appliances, or braces as they are commonly called, on their teeth, and have realized they were there for the purpose of regulating or straightening the teeth. These individuals no doubt were children, as it is during the early years of life that the treatment necessary in bringing about the desired results, namely, normality of jaws and teeth, may be most successfully accomplished. The dentist whose function it is to straighten teeth is known as an orthodontist. It has not been a great many years that it has been known that irregular teeth might be straightened. The desire of parents to have their children's teeth arranged as nature intended them to be is usually brought about by the fact that irregular teeth are most unsightly, and in extreme cases constitute a serious handicap to the appearance of the individual possessing them. This is most certainly true, and its correction is certainly desirable. By far the most important factor concerning irregular teeth lies in the fact that they constitute a serious menace to good health.

Irregular teeth are but a symptom of a condition—they indicate the presence of underdeveloped misshapen jaws, or jaws out of their proper relationship one to the other. The condition of underdeveloped jaws, that is, jaws too small to accommodate all of the teeth, with crowding of the teeth resulting, is probably most commonly encountered. Why the jaws of present-day children are too small for all of the teeth is a subject for discussion at the present time. An insufficient amount of rough food, which calls for exercise of the jaws and insures their consequent growth—a step in man's evolution—and other conditions are among those declared responsible. When jaws are out of their proper relationship one to the other, it is the lower jaw which is not in its proper place. The lower jaw is the movable one, and may be too far forward or too far backward. The upper front teeth may protrude, but the upper jaw itself is fixed or stationary, and is a part of the skull. The roof of the mouth, commonly called the hard palate, forms the floor of the nose, a fact which I shall refer to later. Through treatment, it is possible to develop properly the bony framework of the jaws, or cause it to grow to a size where the teeth can be arranged in their proper positions. By treatment, these misshapen jaws are developed to their proper shape. Also by treatment the jaws are placed in their proper positions so that neither one nor the other appears more prominent.

In the ideal arrangement of teeth, as intended by nature, each tooth is a part of the whole chewing machine. Each tooth has a certain function to perform, or work to do, and has a certain position

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to occupy in order that it may best do the work for which it is intended. The front teeth bite off the food, and the side or back teeth grind it. When the teeth are well arranged, food in the process of chewing is held between them by the cheeks outside and the tongue inside them. As it is chewed, it passes over the teeth and over the gums. This gives the gums the stimulation intended by nature to keep them healthy and in good condition. When teeth are irregular, these things are not possible. Food tends to pack and collect around the irregular teeth, which gives a better opportunity for decay to set in. It is always safe to predict that with irregular teeth will come early decay. You are all familiar with the saying, "A clean tooth never decays." While this may not be entirely true in all its aspects, it has much of truth in it.

With the packing and collecting of food about the irregular teeth and on the gums, the latter, too, must suffer. The stimulation of food as it passes over them is not present, and owing to its loss, the gums lose their proper healthy condition. The wedging of food about the necks of the irregular teeth produces an active irritation. Irritation from one of several sources is one of the principal causes of pyorrhea, which is so prevalent among all classes today.

In many cases, when teeth are irregular, those in one jaw do not touch those in the opposite jaw; or if they do, this occurs only on one side or corner of the tooth. In order that the teeth and the gums may be healthy, the teeth must be used. When they are not used, or are used only on one side or corner, they become tender and lame, or sore. The gums about the teeth become darker than normal, and tartar tends to form on them. The rough tartar acts as an irritant, as a piece of sandpaper would, and the gums recede or draw away from the teeth. Later, because the gums which support the teeth have drawn away, the teeth become loose, and eventually they are lost through pyorrhea. You have all heard it said that four out of five teeth are lost because of it. When the teeth are thus lost, it is necessary that some artificial substitutes be resorted to. From the standpoint of efficiency, no substitute can equal your own natural teeth. As some one has said, "The Lord gave us our teeth and there is no doubt as to the possibility of dentists improving on His work."

Up to this point, I have been speaking of the health of the teeth and gums themselves. A regular set of teeth is a most necessary adjunct of the general good health. When we stop to analyze our most important functions, we discover they are chewing and breathing. With the loss of either, we would cease to exist. By the proper chewing of our food, good digestion is made possible, growth is promoted and good health is maintained. Proper chewing of food is impossible with irregular teeth. Thus, normal metabolism and growth are impossible, and the child's general development is bound to suffer. Improperly chewed food throws an overload on the stomach and other digestive organs, and in time will produce disorders harmful to the individual. A child's resistance may be high; he may be of a very healthy type, and this overtaxing may cause no apparently harmful effects upon him. Later in life, when resistance is not so high, these effects are most liable to become evident and digestive disorders result. A regular arrangement of the teeth is good insurance against these troubles in later life.

Associated with certain types of irregular teeth we always find mouth breath-

ing. By nature, it is intended that we breathe through the nose with our lips closed. With the types of irregular teeth commonly spoken of as protruding upper teeth or a protruding lower jaw, in many cases it is impossible for the child to breathe with the lips closed. The teeth prevent it, and sufficient air cannot be secured unless the mouth is open. I have already referred to the fact that the roof of the mouth forms the floor of the nose. When the upper jaw is underdeveloped and is narrow, as is often true, the sinuses or air spaces in and back of the nose are also small, underdeveloped and incapable of performing their proper functions, having to do with the passage of air to the lungs.

The lungs themselves may not develop properly under these adverse conditions. The air which we breathe through the nose, under normal conditions, is therein, and in the air spaces in and back of it, properly warmed, and with the impurities taken out before it passes to the lungs. A mouth breather carries to the lungs air which is not properly prepared and thus throws an overload on them, and in this manner overtaxes them.

Not infrequently, with narrow undersized jaws, with the teeth crowded and bunched together, we find an extremely nervous disposition. This is brought about by the fact that the nerves leading from the teeth are crowded and bunched, and because of this are irritated, causing nervous disorders even as severe as chorea, or St. Vitus' dance. So small an irritant as a grain of sand in the eye can cause much discomfort to the nerves of that organ. It is not so difficult, then, to understand that the presence of the crowded nerves of the teeth may cause serious nervous disorders in the growing child.

One of the important functions of the teeth is to aid in speech. The correct shape of the jaws and the correct positions of the teeth are necessary in the formation of many sounds. The presence or absence of the teeth is not so important as is the shape of the mouth, especially of the roof, which acts as a sounding board, and on which normal speech depends to a considerable degree. Without correct conditions the voice does not carry, speech is unintelligible and there is a mouthing of sounds. Such conditions cause great handicaps.

It has already been mentioned that the parent's attention is called to the child's irregular teeth by the fact that they are unsightly. While it is true that the health phase is most important, the appearance of the teeth has a great deal to do in the formation of the character and even eventually the success of the individual.

Given a reasonable degree of health and mental equipment, the growing child may develop successfully and establish traits which will result in success and happiness. Unfortunate facial deformities which accompany irregular teeth may constitute a serious handicap in the development of the child. A child with a receding chin, protruding upper teeth, or a short upper lip is often judged stupid because of its appearance. The child thus judged usually notices this attitude and may become more or less convinced in his or her own mind that this is a true fact and develop traits of indecision and weakness which go to make for the development of the inferior complex of which we hear so much these days. The protruding lower jaw with its pugnacious appearance has often caused its owner to be associated with traits of character which are not at all his or hers.

Many a boy has had a miserable time of it through possession of a jaw of this character, but lacking the physical ability in his right arm to back it up. Self confidence and poise are so essential to success and happiness in later life that these hardships should be remedied at an early age.

THE TIME TO STRAIGHTEN CROOKED TEETH*

By LELAND R. JOHNSON, D.D.S., M.S.D., Chicago, Ill.

A FEW days ago, I was walking through a store, and as I passed a counter on which were displayed a number of false faces, the thought occurred to me that many of us are already wearing false faces; "faces which nature did not intend that we should wear."

We have only to look about us to see many faces that are lacking in personality and attractiveness simply because of the deformity caused by crooked teeth. You are famliar with the different types of faces, such as the undershot lower jaw and the "Andy Gump" or fade away chin with its accompanying protrusion of the upper front teeth. But there are many variations of these two general types which, to the more experienced eye, immediately cry out "crooked teeth."

Beauty is the birthright of every child; but many children are robbed of that birthright while still very young, by the abnormal action of the outside and inside forces which govern the final shape of the jaw bones and the development of the face of the individual.

As parents, your child's future is naturally your greatest concern. No mother, knowingly, would permit her baby, with its pink dimpled cheeks and heavenly expression, to grow into manhood or womanhood with a face unpleasant for others and even the individual himself to see. But many times this very thing happens, and not because of neglect on the parents' part but because they have been ill advised.

So many times, we hear the expression "Don't worry about it—wait and see if the second teeth won't come in straight," or "Wait, maybe nature will straighten them out." And then, after we wait, the teeth become no better, and in all probability become worse. We then realize that it is too late to accomplish the nice result we should have. True, something can be done, even for the adult. It is not entirely hopeless, but the result will not compare with the result attained by treatment when the child is growing and developing.

The problem which confronts us is not merely the movement of teeth, but is one of growth and development. Nature, in the development of the child's face and jaws, has become sidetracked and is developing a deformity instead of a normal, harmonious face and chewing mechanism.

During this age of growth and development, the bones of the child are soft and easily molded. Slight, abnormal pressure produced by faulty habits or other conditions will easily initiate a deformity which, if developed by nature, would result in perhaps one of the worst types of crooked teeth. At this time, the bones of the child will also readily respond to guided pressure furnished by means of an appliance, and can be molded into their proper shape through move-

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ment of the teeth into their normal positions, the elimination of wrong habits, the return to normal function and the proper exercising of muscles which are lacking in tone and vigor.

If we have planted a vine and we wish it to grow in a certain direction, we entwine the delicate little tendrils about some object in the direction that we wish the vine to grow, and it grows that way. But think of the difficulty that we would encounter if we waited until the vine was grown and then attempted to train its woody stalk to grow in the direction we wished. Failure would be the result.

This period of growth and development, then, is the best time for man to interfere and correct the developing deformity and give nature a new start by bringing the child's mouth to what we consider the normal for him at that time. Then nature is given the opportunity to develop the child as he normally should develop.

The appliance which is used to correct this condition is an aid to nature and furnishes a gentle stimulation which is transmitted to the bone cells of the jaws through the teeth. Then nature begins its growing process and is guided in the direction desired by the appliance subject to the will of the operator.

The ideal time to straighten crooked teeth is between the ages of 3 and 10 years, since the child is passing through some of its most active periods of growth and development between these ages. Many severe types of crooked teeth, which it would take years to correct later in life, may be corrected by a few months of treatment early in life. However, it is possible to treat children over 10 years of age.

Every type has its beginning in some mild form. Perhaps only one tooth is out of line or some innocent little habit is viciously changing the shape of the mouth. And these apparently trivial things, if permitted to develop, increase in proportion until the child's face is deformed. A deformed face can be improved very much by having the teeth straightened, but nature can develop an attractive face much better if put back on its true path when the deformity is in its beginning.

"But," you ask, " how can I recognize these conditions when they are only beginning?"

1. Watch the baby teeth. They are extremely important. They are the advance agents preparing the jaws and developing the face for the second teeth, which are following them in the trail that they have blazed. The developing buds of the permanent or second teeth lie in the jaw bones just beneath the baby teeth ready to push up and take their places in the line as soon as the baby teeth have accomplished their purpose and are shed.

2. Every baby tooth must function as nature intended, or trouble begins. One of the functions of the baby molars is to hold enough space between the first permanent molar and the baby cuspid tooth to accommodate the two bicuspids of the second set which follows. If a cavity appears in one of these baby molars and is not filled and shaped to the original form and dimensions of the tooth, the force in the back of the jaws, which is always pushing the jaws and teeth forward, pushes the back teeth forward and takes a part of the space the baby tooth was holding. Then there will not be room for the second teeth to take their places. The last one to take its place in the row will be the one that will be crowded out, and this usually is the cuspid, which comes in at about 12 years. A great many times, the condition known

as "buckteeth," or "tusks" will be the result. Avoid this condition early by taking the child to your dentist every six months so that cavities may be discovered and filled.

3. At about 5 to 6 years of age, the jaws begin to prepare for the wider permanent front teeth which are soon to come in and spaces begin to develop between the upper and lower front teeth of the baby set. These are called developmental spaces, and if they do not occur, the front teeth of the second set will probably be crowded; which means bunched and crooked front teeth. Watch for these spaces. If they do not appear, corrective treatment should be instituted. The necessary space can be provided in a short period of time.

4. If your baby has sucked his thumb or a pacifier, break him of the habit as early as possible and take him to an orthodontist as soon as he is 3 years old. Sucking his thumb has probably caused the lower jaw to become locked too far back in its relation to the upper jaw. The baby roots are fully formed at the age of 3, and the jaw relation can be corrected best between 3 and 4½ years of age. This will also apply to those cases in which the lower front teeth bite outside the upper front teeth. It is very important that this last mentioned condition be remedied at this age because the lower jaw will become overdeveloped and the upper jaw underdeveloped, that undershot, pugnacious appearance, which it is so difficult to correct later in life, resulting.

5. Another symptom of a developing facial deformity which is easily recognized is mouth breathing. In this instance, the child should be taken to the physician immediately for an examination for adenoids, and, if they are present, they should be removed without delay.

In mouth breathers, we usually find the upper jaw quite narrow and the palate is high and V-shaped. This decreases the breathing space in the nose. One of the functions of the nose is to warm the air as it passes through to the lungs. This does not happen in the patient who breathes through the mouth, and consequently this type of individual is much more susceptible to respiratory diseases. The teeth are not bathed in saliva as they normally should be with the mouth closed and are much more liable to decay.

With this condition present, the food cannot be properly chewed and prepared for the stomach; the stomach is overworked, the resistance is lowered, and normal development of the jaws and body in general is interfered with to the extent that the mouth condition grows worse. Thus, that never ending cycle continues, until something is done to stop it.

The earlier the mouth breather's teeth are straightened, the better; and it goes without saying that it should be done while the child is in its early growing stages. Widening the narrow upper arch and breathing through the nose permits the air pressure in the nose to push down its floor, thus giving the child more breathing space and permitting a normal development of the upper half of the face.

Crooked teeth must be viewed not only from the appearance angle but also from the standpoint of health. The normal or abnormal positions of the teeth and jaws are vital factors in the health of the individual.

In conclusion, I wish to emphasize the fact that any type of crooked teeth should be corrected as soon as the deformity is evident.

But, after all, the ideal treatment for all conditions is preventive. "An ounce

of prevention is worth a pound of cure." My appeal to you is for the health, beauty, and individuality of your children. Share the responsibility with a reputable dentist by having them examined at 3 years of age, and let him advise you and guide them through the period of growth and development, thus assuring them of a priceless asset in their womanhood and manhood—straight teeth.

WHAT DECAY IN TEETH CAUSES*

By F. S. TITTLE, D.D.S., Oak Park, Ill.

DECAY in the teeth may be detected by the patient through a sharp toothache, which may be brought on by biting into candy, by allowing the tooth to come in contact with cold air or by eating hot or cold foods. This is especially true if the decay begins on the surface of a tooth which lies next to another tooth. Ache in a tooth is always preceded by decay. In itself, it is not a serious condition. It may cause the patient to lose sleep and to suffer considerably, but that is only a warning of the greater dangers ahead.

When a tooth aches badly, it means that the nerve of the tooth is exposed or that the decay has reached the nerve. This is a very serious condition for any tooth and consequently serious for the individual. It means that one of two things should be done: Either the nerve should be removed or the tooth should be extracted. So you see that decay may be the cause of the loss of the nerve or the loss of the tooth.

It should not be necessary to dwell on the misfortune of losing a tooth. Nearly everyone knows that each tooth has a definite function to perform. If one of the teeth is missing, our chewing apparatus is affected, and we have a situation similar to that of an automobile with one of its cylinders missing. An important function of any tooth, aside from grinding food, is to hold the teeth on either side of it in their proper positions. If a tooth is lost, the teeth on either side tip toward the vacant place, the teeth next to these teeth move slightly toward the empty space, and so on. Thus, the loss of a single tooth may mean the impairment of the efficiency of every tooth in the jaw. This slight movement of the teeth in the jaw where the tooth was extracted is enough to disturb the teeth in the opposite jaw. When a tooth is lost it means the loss of the usefulness of the tooth in the other jaw which came in contact with it during mastication.

What I have just said applies not only to adults' but also to children's teeth; but because the baby teeth and the first permanent molar are so often neglected, I wish to mention some of the results of decay in these teeth. Some people believe that it is not necessary to care for the baby teeth. This is a fallacy; but, in the past, it has been responsible for the premature loss of many baby teeth and also of the first permanent molar. Of course, decay is the cause of the premature loss of these teeth.

The first permanent molar is the most important tooth to the child as well as to the adult. It is frequently called the "six-year molar," because it makes its

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appearance during the sixth year. There are four of these teeth, one on each side in the upper jaw and the same in the lower jaw. They come in just behind the second molars of the first set of teeth. These first permanent molars come through the gums without causing any trouble. They do not take the place of any baby teeth. For these reasons, they are frequently mistaken for baby teeth. One way to determine whether or not a molar tooth is the first permanent molar or one of the molars of the baby set is to start with the central tooth in front and count toward the back. If there are six teeth on one side in counting from the center, the sixth tooth is the first permanent molar. There are only twenty of the baby teeth, five on either side of the central line, upper and lower.

The first permanent molar frequently decays soon after it erupts, not only for the reason that it is so frequently overlooked, but also because of its form. On its biting surface, there are elevations called "cusps," and depressions called "grooves." In the center of the groove, there is a pit. The enamel many times is not well formed at the bottom of the pit. It is difficult to brush this pit properly and for that reason decay often starts as soon as the tooth gets through the gums.

A moment ago, I told you that the first permanent molar is the most important tooth in the mouth. We will now show you that this is true by enumerating some of its many functions. In the first place, it is the largest tooth in the mouth, and because of that and the location which it occupies in the jaw, it is the most important tooth for grinding the food.

The upper first permanent molar does not come squarely over the lower when the teeth are closed together, but is slightly back of the lower. This position, which is natural, brings one of the elevations or cusps of the upper tooth into the groove of the corresponding lower tooth. This produces an interlocking of the upper and lower molars, so that both are held firmly in place when the mouth is closed. When the baby teeth are retained in the mouth as long as they should be, the first permanent molars always take their normal position. The importance of all this is that the first permanent molars come into place and lock themselves into position before the baby teeth begin to come out. In this manner, the first permanent molars hold the proper relationship of the two jaws while all of the baby teeth are being shed and the permanent teeth are taking their positions. If this relationship is not kept, there is sure to be a crowding of the permanent teeth, and an overlapping of their surfaces, producing a condition called "crooked teeth."

Let us turn our attention now to the baby teeth. Like all permanent teeth, they are intended for mastication of the child's food. Just prior to the appearance of the permanent teeth, the baby teeth loosen one by one and are shed to make way for the permanent ones. In addition to the mastication of the child's food, the baby teeth hold the position and space for the permanent teeth. The second molar of the baby set also guides the first permanent molar into its position just back of it.

Baby teeth and the first permanent molar are lost from the results of decay in them. When any baby tooth is lost prematurely, we have results similar to that produced by the loss of a permanent tooth, only worse. The teeth on either side of the space close in, and the permanent tooth, which needs all of that space, cannot come in except it be inclined toward the tongue or out toward the

cheek. In either case, there will be irregularity, and a more or less prolonged treatment of straightening will be necessary to put them in their proper position. The most important baby tooth is the second molar. If this tooth is prematurely lost by decay, the first permanent molar will tip forward so that it will not meet the molar above as Nature intended, and consequently there will be no interlocking, as I have stated before. Decay, then, is the cause of the premature loss of the baby teeth, and their early loss is the principal reason for all irregularities in the arrangement of the permanent set of teeth. When the teeth do not have enough room in the jaw, the bone is underdeveloped. This frequently causes an underdevelopment of the other bones of the face.

Decay in the baby teeth may cause an increase in the communicable diseases of childhood. The cavities make a fine place for all kinds of germs to grow. It has been proved in various cities that the number of cases of measles, scarlet fever, diphtheria, etc., have been reduced by more than 50 per cent just by filling the cavities in the children's teeth and teaching them how to use a toothbrush correctly. It has also been proved, in every place where it has been tried, that schools occupied by children who have their teeth properly cared for have fewer repeaters than other schools. This is quite a saving in money to the taxpayers. It is also a great saving in time for the children.

In the remainder of our time, let us consider the effects that may be produced by losing the nerve in a tooth. In the great majority of cases, the nerve is lost as a result of decay in the tooth.

Very frequently, a tooth with an exposed nerve is not treated by a dentist. I will now give you the inevitable results of exposure of the nerve which is allowed to run its course. In the first place, the nerve becomes infected by the disease forming germs which are always present in the mouth. As a result of this infection and irritation, the nerve is killed. Usually, this is a slow and gradual process.

As the nerve dies, it naturally loses its resistance. This permits the infection to proceed to the end of the root of the tooth. If it stopped there, the final condition would not be nearly so bad, but the bacteria or germs pass through the root of the tooth into the soft tissues beyond. That is the place where infection is dangerous. The principal focus of infection about the teeth is here. It is from this focus, or seat, that infection is spread by the blood stream to all parts of the body.

When we speak of infection of the various parts of the body, we should bear in mind that certain germs will attack a certain organ of the body. For example, the germ of tuberculosis usually attacks the lungs; the typhoid germ attacks the intestinal tract; the germ of meningitis attacks the brain and spinal column.

The germ which most frequently infects the teeth is known as the streptococcus. There are various strains of streptococci, each with a definite affinity for a certain part of the body. This has been proved by taking the germs from infected teeth of a person who was suffering from another disease and injecting these germs into a guinea-pig. If the person was suffering from heart disease, the guinea-pig would develop heart disease; if the patient was suffering from rheumatism, the guinea-pig would contract rheumatism.

It is now generally accepted by all students of the subject that the following diseases may have their origin in and about the teeth: neuritis, neuralgia,

kidney infections, rheumatism, arthritis, infection of the intestines, appendicitis, sinusitis, anemia, etc., all of which go back to the original cause of decay.

In conclusion, let me summarize some of the results of decay in teeth:

1. Decay in teeth may cause toothache.

2. Decay may cause the loss of the nerve of a tooth and the loss of the nerve may cause all sorts of systemic disease.

3. Decay may cause the loss of the tooth. This may disturb the entire biting efficiency of all the teeth.

4. Decay in baby teeth may be the cause of all kinds of irregularities in the permanent set.

TEETH THAT SHOULD BE EXTRACTED*

By D. M. HODGMAN, D.D.S., Chicago, Ill.

THE question as to what teeth should be extracted is a problem that interests most all of us very vitally at some time or another.

A mistake that is made by the great majority of people is the delay in having a tooth removed that they know should be extracted. This delay often gives the inflammation more time to advance, and when extraction is done, the possibility of after-complication and trouble is increased.

Many people wait until they are in extreme pain and there is considerable swelling present before they seek the aid of the dentist. This is not an ideal time to have the tooth removed, and what should be a very simple extraction now becomes somewhat of an ordeal, owing to the delay in having this tooth cared for at an earlier date, when it was not giving extreme trouble.

Pulpless teeth, that is, teeth that have had the nerve removed, are often incorrectly spoken of as dead teeth. They are not dead teeth, for the membrane that covers the outside of the roots is very much alive even though the nerve in the tooth is gone.

Pulpless teeth are as a rule considered with a certain amount of suspicion by the dental and medical professions. The reason for this is that so many of the teeth that have had the nerves removed and the canals in the teeth treated and filled develop an area of infection at the root ends. This area of trouble at the end of the tooth in most instances does not cause any sharp pain, and for this reason, the tooth is allowed to remain in the mouth long after the time that it should have been extracted. It is this type of infection that is the cause of, or a contributing cause to, many cases of trouble in other parts of the body. It has been proved beyond all doubt that infection about the teeth will in some cases cause many bodily ailments, such as heart trouble, disturbance in the joints, indigestion, nervousness, loss of weight, eye trouble and neuralgia. In many instances, people suffer some form of bodily ailment that the teeth are the indirect cause of, but the teeth have not been considered because no pain has been felt locally in the mouth.

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In considering the trouble that may come from pulpless teeth, we must realize that all such teeth are not infected. A great many teeth that have had the nerves removed and the canals filled remain in the mouth in a state of health and give years of service.

In deciding what pulpless teeth to have extracted, it is necessary to have the advice of your dentist, who takes into consideration the past history of the tooth as well as the evidence of the x-ray picture of the tooth. The x-ray pictures are a great help in deciding which of these teeth should be removed, but it is all important that other symptoms be considered in conjunction with the x-ray findings. In many instances, the physician's report on the general condition of the patient should be very seriously considered.

It is generally recognized that a person in good health has a degree of bodily resistance that makes it possible for him to carry a number of pulpless teeth, while the person who is not up to par does not seem to be able to tolerate pulpless teeth even though the work done on the teeth is of a similar character in both instances.

It is a very good plan to check the condition of the pulpless teeth at intervals of at least twelve months with a good x-ray picture.

Considering next the problem of abscessed teeth: There are many angles to be gone into as this condition may exist in varying degrees. We will speak first of the tooth that has an area of chronic infection about some portion of its root. This is a condition that has existed for a long period of time and, in most instances, has destroyed a considerable amount of bone as well as part of the membrane of the tooth and a certain portion of the root structure itself. An area of infection of this type often burrows through to the surface of the gums, and we have the condition spoken of so often by the laity as "gum boil."

You can well realize that a tooth in this condition should not be left in your mouth.

Teeth that are just beginning to abscess, and in which the infection has not caused such destruction as we have just described, can, in many instances, be treated and a cure obtained. This is especially true of the six upper and the six lower front teeth, for they are single rooted teeth and contain a single root canal, which in most teeth is straight. This makes it possible for the dentist to gain access to the area of trouble, and the treatment will have a better opportunity of success.

We find that it is difficult for the laity to realize that a tooth can be abscessed and still not cause any pain or swelling. For this reason, many people are harboring infected teeth that should be taken care of. If the infection about a tooth cannot be successfully treated, this tooth should be extracted even though it doesn't happen to be causing pain.

The abscessed tooth that is causing pain, soreness and swelling usually gets immediate attention, for the individual cannot tolerate such a reaction for any length of time.

The idea that a sore tooth must not be extracted is not entirely true by any means. There are cases in which treatment is necessary before extraction, but this is something for the dentist to decide. In most ordinary cases, the tooth can be extracted, and relief is obtained at once.

The x-ray film is a necessity in determining what to do with abscessed teeth, for it gives us a definite picture of what destruction has taken place on or about the roots of the teeth.

Some areas of infection on the roots are walled off by nature into a sack, but that is not true of all abscessed teeth, for, in many instances, the infection does not wall itself off; and, in this instance, the infection may spread much more rapidly and destroy a great amount of bone.

Pyorrhea is a disease of the gums and bone that surround the teeth, and, in many pyorrhea cases, it is necessary to extract the teeth that are involved. Pyorrhea, when it exists in a mild form or when the condition is just starting, if given proper treatment may be held in check, and it will not be necessary to lose any teeth.

In cases that do not respond to treatment, but seem to grow steadily worse, we must consider extraction. In this type of case, it is a great mistake to delay the extraction for too long. Teeth of this nature may temporarily wreck one's health.

The second important reason why these teeth should be removed is to preserve the ridge in the mouth upon which the plate will have to rest. When extraction is delayed, the pyorrhea may so attack and destroy the dental ridge that plates can be worn later only with great difficulty, if at all.

Pyorrhea in a mouth does not always spread to all the teeth. We find many cases in which an individual tooth is attacked. These teeth should be treated without delay, and if they do not respond to treatment, they should be extracted before the next tooth becomes affected. No one would want to lose a tooth if it could possibly be retained in a healthy state, but the mistake is often made of keeping pyorrheic teeth long after they should have been extracted.

Unerupted or impacted teeth are teeth that, for some reason, have never come through the gums in the normal way. Some of these teeth are in such a position in the jaw bone that they can be seen and located only with an x-ray, while others may be partly through and visible in the mouth. The ones that are most commonly impacted are the wisdom teeth, or third molars, and cuspid teeth, often called eye teeth; although any tooth in the mouth may be impacted.

The majority of impacted teeth should be removed. Impacted teeth that are allowed to remain are in many instances eventually, a source of great trouble. Third molars are very often impacted against the roots of the second molars, and when extraction is delayed, the second molar tooth is ruined because the pressure of the third molar will cause destruction of the root of the adjoining second molar.

Many impacted or partially erupted teeth are a source of infection when some portion of the tooth is exposed to the surface. There is a pocket about the crown portion of these teeth that it is almost impossible to clean. Inflammation starts very rapidly in this area and many times proves very serious.

In many cases, irregularity or crowding of the anterior teeth is due to the pressure of third molars in their effort to erupt, and, in these cases, it is wise to extract the third molars before this damage is done.

The ideal time to have an unerupted tooth extracted is before the tooth has had time to cause damage to other teeth or injure one's health by creating an area that easily becomes infected.

Third molars appear in the mouth usually about the eighteenth year. The time of eruption varies. It is a very good plan at this age to have the dentist check up on the third molar teeth, to determine whether they are in the normal position and there will be room for them

without crowding the other good teeth that are in the mouth.

The question as to what teeth should be extracted for children is a serious one. It is necessary that the first teeth be given the best of care, and all children should visit the dentist at regular intervals. When a child's tooth is abscessed, it is necessary, in most all instances, to extract the tooth. If a first tooth is lost by extraction long before the time that it should be shed, it is wise to have the dentist retain the space by placing a bar in position.

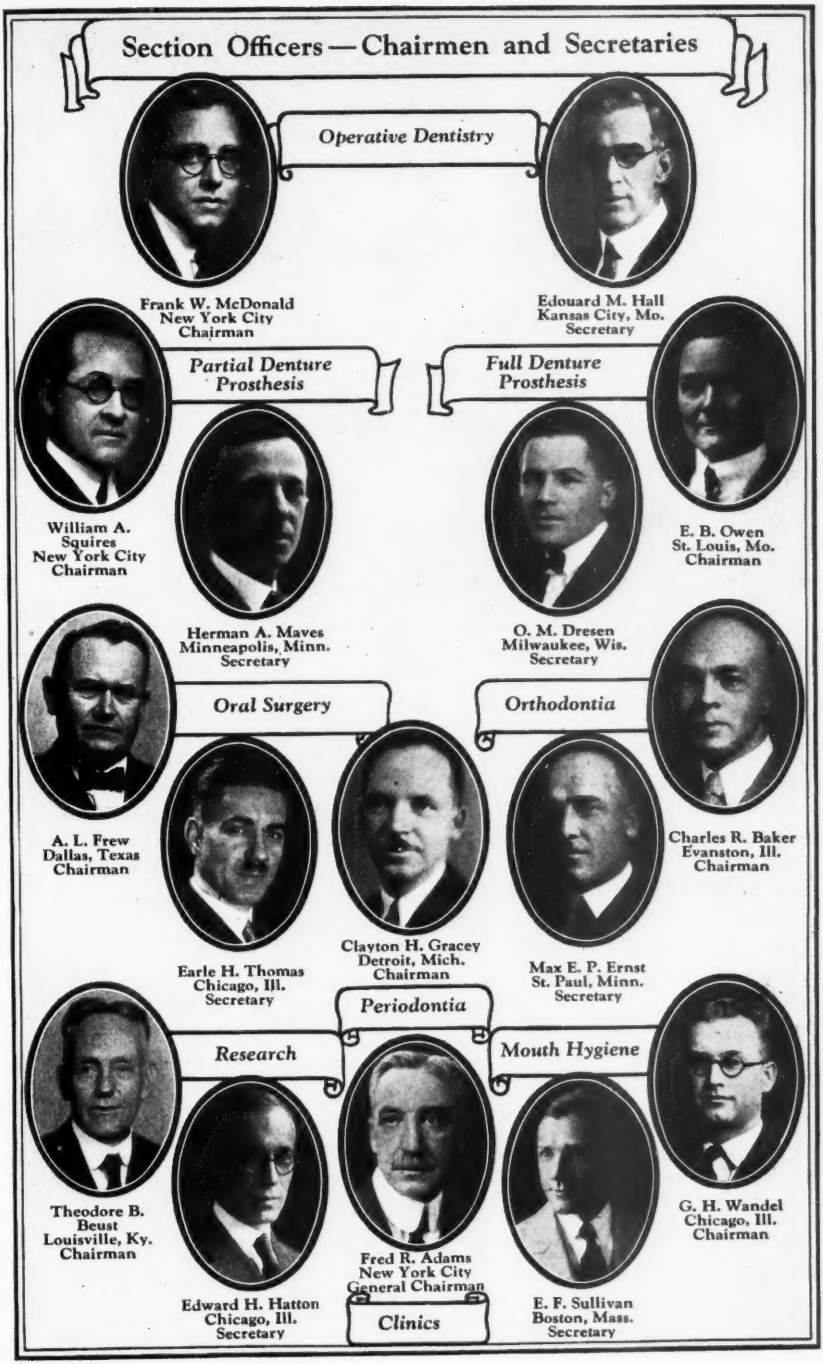
When the normal time arrives for the first teeth to be shed, it is important that they be removed. If Nature does not cause the loss of these first teeth, your dentist should extract them whenever it is necessary.

In dealing with decayed teeth from the standpoint of extraction, we can say that a tooth should never be extracted just because there is a cavity present. Many wisdom teeth or third molars seem to decay very rapidly, and, in this instance, it is not always well to attempt repairs; but your dentist can best advise about this, for it is necessary to consider these cases individually. Teeth that are decayed beyond repair should always be extracted, and the extraction should not be delayed, for complications are very liable to occur.

It is necessary to extract some teeth that become split or cracked but that are otherwise normal teeth. These cases usually arise from accidents, and we often find the teeth so injured that extraction is necessary.

If a tooth is in such a position in the mouth that it rubs or irritates the tongue or cheek, this tooth should be extracted. A tooth of this nature that is a constant irritant can eventually cause very serious trouble.

To sum up the entire problem: We urge you not to delay in caring for a tooth that you know needs attention, and it is well to check upon the teeth with a complete x-ray examination from time to time, in order to be sure that you are not harboring any teeth that may be injuring your general health.



CHAIRMEN AND SECRETARIES OF THE SCIENTIFIC SECTIONS OF THE AMERICAN DENTAL ASSOCIATION, 1929

AMERICAN DENTAL ASSOCIATION SEVENTY-FIRST ANNUAL SESSION

WASHINGTON, D. C., OCT. 7, 8, 9, 10, 11, 1929

OFFICIAL CALL

To the Members of the American Dental Association:

You are hereby notified that the Seventy-First Annual Session of the American Dental Association will be held at Washington, D. C., Oct. 7-11, 1929.

The House of Delegates will convene at 10:00 o'clock in the forenoon and at 2:30 o'clock in the afternoon, Monday, October 7. The third meeting of the House of Delegates will be held on Wednesday, October 9, at 2:30 o'clock, and the fourth meeting of the House of Delegates will be held on Thursday, October 10, at 2:30 o'clock. All meetings of the House of Delegates will be held in the Mayflower Hotel. The Credentials Committee will register Delegates and Alternates beginning at 10:00 a. m., Sunday, October 6, at the Mayflower Hotel.

All other members must register at the Registration Office in the Washington Auditorium. The Registration Department will be open from 10:00 a. m., until 5:00 p. m., on Sunday, October 6, and from 8:30 a. m., until 5:00 p. m., on Monday, Tuesday, Wednesday, Thursday and Friday, October 7, 8, 9, 10 and 11.

The general meeting, which constitutes the opening exercises of the Session, will be held Tuesday, October 8, at 9:30 a. m., in the Mayflower Hotel. The second and third general meetings will be held on Tuesday and Wednesday, October 8 and 9, at 8:00 p. m., in the Continental Memorial Hall and the Mayflower Hotel, respectively.

The various sections, general clinics, section clinics, dental health exhibit, scientific exhibit, motion picture program and commercial exhibits will be held in the Washington Auditorium, according to their respective programs.

The constituent societies are hereby notified to file with the Secretary of this Association, at least thirty (30) days prior to the first day of said Annual Session, a list of the names and addresses of their Delegates and Alternates.

PERCY R. HOWE, *President.*
HARRY B. PINNEY, *Secretary.*

GENERAL PROGRAM

Registration (General) ..... Sunday, October 6, 10:00 a. m.
(Washington Auditorium)

Registration (Delegates and Alternates) ..... Sunday, October 6, 10:00 a. m.
(The Garden, Mayflower Hotel)

Board of Trustees (First Meeting) ..... Saturday, October 5, 10:30 a. m.
(North Room, Mayflower Hotel)

Board of Trustees (Second Meeting) ..... Saturday, October 5, 2:30 p. m.
(North Room, Mayflower Hotel)

House of Delegates (First Meeting) ..... Monday, October 7, 10:00 a. m.
(The Garden, Mayflower Hotel)

House of Delegates (Second Meeting) ..... Monday, October 7, 2:30 p. m.
(The Garden, Mayflower Hotel)

House of Delegates (Third Meeting) ..... Wednesday, October 9, 2:30 p. m.
(The Garden, Mayflower Hotel)

House of Delegates (Fourth Meeting) ..... Thursday, October 10, 2:30 p. m.
(The Garden, Mayflower Hotel)

PRELIMINARY PROGRAM FOR WASHINGTON SESSION

FIRST GENERAL MEETING

(Ballroom, Mayflower Hotel)

TUESDAY, OCTOBER 8, 1929

9:30 a. m. Music (Orchestra)

10:00 a. m. Invocation
Dr. James Shera Montgomery, Chaplain, United States House of Representatives ..... Washington, D. C.

10:05 a. m. Music (Solo)

10:15 a. m. Address of Welcome from Washington, D. C.
Hon. Proctor L. Dougherty, President, Board of Commissioners, District of Columbia ..... Washington, D. C.

10:30 a. m. Address of Welcome from the District of Columbia Dental Society
Sterling V. Mead, President ..... Washington, D. C.

10:45 a. m. Response of American Dental Association
Harry W. Nelson, Vice-President ..... Minneapolis, Minn.

11:00 a. m. Music (Orchestra)

11:10 a. m. President's Address
Percy R. Howe ..... Boston, Mass.

11:25 a. m. Music (Orchestra)

SECOND GENERAL MEETING

(Continental Memorial Hall)

TUESDAY, OCTOBER 8, 1929

7:45 p. m. Music—United States Army Band
(Music furnished by this band under the auspices of the Military Dental Surgeons.)

8:00 p. m. Solo (Cornet)

8:10 p. m. Greetings—Hon. Charles Curtis, Vice-President of the United States

8:30 p. m. Music—United States Army Band

8:40 p. m. Address
Merritt W. Ireland, Surgeon General, United States Army..Washington, D. C.

8:55 p. m. Address
Charles E. Riggs, Surgeon General, United States Navy....Washington, D. C.

9:10 p. m. Music (Vocal Solo)

9:20 p. m. Address
Hugh S. Cumming, Surgeon General, United States Public Health Service.....Washington, D. C.

9:35 p. m. Music—United States Army Band

THIRD GENERAL MEETING

(Ballroom, Mayflower Hotel)

WEDNESDAY, OCTOBER 9, 1929

7:45 p. m. Music (Orchestra)

8:00 p. m. Greetings from France
Georges Villain .....Paris, France

8:15 p. m. Music (Solo)

8:25 p. m. Address: "Evolution and Heredity"
George H. Parker, Professor of Zoology, Harvard University
(Introduced by Senator Henrik Shipstead of Minnesota)

Music (Orchestra)

THE SCIENTIFIC SECTIONS

TUESDAY, OCTOBER 8

OPERATIVE DENTISTRY, MATERIA MEDICA AND THERAPEUTICS

OFFICERS OF SECTION

Frank W. McDonald, Chairman.....
.....New York City

Harry B. McCarthy, Vice Chairman.....
.....Baltimore, Mo.

Edouard M. Hall, Secretary.Kansas City, Mo.

2 to 5 p. m.

"Oral Diagnosis"
By R. W. Edwards....Kansas City, Mo.
Discussed by
George W. Christiansen..Detroit, Mich.
Alan S. Wolfe.....Washington, D. C.

"Traumatic Occlusion and Its Application in the Field of Operative Dentistry"
By John Oppie McCall...New York City
Discussed by
Leo A. Walzak.....Baltimore, Md.
A. W. Bryan.....Iowa City, Iowa

"Dental Economics as Applied to Everyday Practice"
By John C. Warnock...Kansas City, Mo.
Discussed by
W. Ray Montgomery.....Buffalo, N. Y.
Edwin N. Kent.....Boston, Mass.

FULL DENTURE PROSTHESIS

OFFICERS OF SECTION

E. B. Owen, Chairman.....St. Louis, Mo.
G. W. Holliday, Vice Chairman.....
.....Richmond, Va.
O. M. Dresen, Secretary....Milwaukee, Wis.

2 to 5 p. m.

"Slighting the Little Things in Denture Construction"
By B. C. McEuen.....Madisonville, Ky.
Discussed by
H. F. McGrane.....Omaha, Nebr.

"Synthetic Resins—Their Place in Dentistry"
By A. Alfred Nelson.....Detroit, Mich.
Discussed by
John H. Hospers.....Chicago, Ill.
K. W. Knapp.....Philadelphia, Pa.

"Roentgenograms Pertaining to Bone Changes as Affecting Denture Stability"
By Howard H. Jackson...Detroit, Mich.
Discussed by
Clarence O. Simpson.....St. Louis, Mo.

PARTIAL DENTURE PROSTHESIS

OFFICERS OF SECTION

William A. Squires, Chairman.....
.....New York City
F. F. Whitcomb, Vice Chairman.....
.....Omaha, Nebr.
Herman A. Maves, Secretary.....
.....Minneapolis, Minn.

2 to 5 p. m.

"Cavity Preparation, Stressing Particularly Preparations for Abutments"
By R. E. Blackwell.....Chicago, Ill.
Discussed by
Henry W. Gillett.....New York City

"Sectional Impressions for Partial Dentures"
By F. E. Roach.....Chicago, Ill.
Discussed by
T. W. Maves.....Cleveland, Ohio

"Problems of Occlusion as Related to Partial Denture Construction"
By Victor H. Sears.....New York City
Discussed by
J. L. Young.....New York City

ORAL SURGERY, EXODONTIA AND ANESTHESIA

OFFICERS OF SECTION

A. L. Frew, Chairman.....Dallas, Texas
Roy S. Hopkinson, Vice Chairman.....
.....Milwaukee, Wis.
Earle H. Thomas, Secretary.....Chicago, Ill.

2 to 5 p. m.

"Photomicrographic Moving Pictures Showing the changes of the Blood Cells Caused by the Action of Hypertonic, Isotonic and Hypotonic Solutions on the Blood Cells of Living Animals"
By Ira G. Nichols.....Champaign, Ill.
Discussed by
John P. Buckley.....Los Angeles, Calif.
Arthur E. Smith.....Los Angeles, Calif.

"Phases of Syphilis Applicable to Dentistry"
By Paul O'Leary (M.D.).....
.....Rochester, Minn.
Discussed by
Frank W. Rounds.....Boston, Mass.
Earle H. Thomas.....Chicago, Ill.

"Pathologic Lesions Involving the Oral Tissues and Adjacent Parts; Surgical and Therapeutic Treatment; Their Relation to the Dental Practitioner"
By Arthur E. Smith...Los Angeles, Calif.
Discussed by
A. T. Rasmussen.....LaCrosse, Wis.
Sterling V. Mead....Washington, D. C.

ORTHODONTIA

OFFICERS OF SECTION

Charles R. Baker, Chairman...Evanston, Ill.
Abram Hoffman, Vice Chairman.....
.....Chicago, Ill.
Max E. P. Ernst, Secretary....St. Paul, Minn.

2 to 5 p. m.

"The Orthodontist's Responsibility in the Prevention of Peridental Disease"
By Egon Neustadt.....New York City

"Considerations Relative to the Orthodontist and the General Practitioner from an Educational, Economic and Professional Standpoint"
By Edward M. Griffin...New York City

"Relation of Thumb and Finger Sucking Habits to Malocclusion of the Deciduous Teeth"
By Samuel J. Lewis.....Detroit, Mich.

PERIODONTIA

OFFICERS OF SECTION

Clayton H. Gracey, Chairman.....Detroit, Mich.
*Gillette Hayden, Vice Chairman.....Columbus, Ohio
*Robin Adair, Secretary.....Atlanta, Ga.

2 to 5 p. m.

"Periodontia and Its Obligations"

"Operative Dentistry"
By LeRoy L. Hartman....New York City

"Orthodontia"
By O. A. Oliver.....Nashville, Tenn.

"Prosthetic Dentistry"
By Edward Kennedy.....New York City

"The General Practitioner"
By W. D. Tracy.....New York City

MOUTH HYGIENE AND PREVENTIVE DENTISTRY

OFFICERS OF SECTION

*Robin Adair, Chairman.. ....Atlanta, Ga.
G. H. Wandel, Vice Chairman..Chicago, Ill.
E. F. Sullivan, Secretary.....Boston, Mass.

2 to 5 p. m.

"What Is Mouth Hygiene?"
By C. J. Hollister.....Harrisburg, Pa.

"How Chicago Arrived at the Present Status in Its Mouth Hygiene Program"
By Lon W. Morrey.....Chicago, Ill.
Discussed by
Grace S. Wightman (M.D.).....Springfield, Ill.

"How Can We Best Interest Our Patients in Oral Hygiene?"
By Maxwell M. Dixon.....Los Angeles, Calif.

"Plea for a More Complete Mouth Examination"
By Edward L. Ball.....Cincinnati, Ohio

"Preventive Dentistry—Its Scope and Possibilities"
By C. N. Johnson.....Chicago, Ill.

"The Dental Hygienist, Her Training and Value"
By Charlotte Klatt Sullivan.....Philadelphia, Pa.

*Deceased.

HISTOLOGY, PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY AND CHEMISTRY (RESEARCH)

OFFICERS OF SECTION

Theodore B. Beust, Chairman..Louisville, Ky.
Russell W. Bunting, Vice Chairman.....Ann Arbor, Mich.
Edward H. Hatton, Secretary...Chicago, Ill.

2 to 5 p. m.

"Diet and Dental Caries in Children with Diabetes"
By C. L. Drain.....Iowa City, Iowa

"Checking Caries by Dietary Procedures"
By May Mellanby....Sheffield, England

"Lactobacillus Acidophilus and Dental Caries"
By F. E. Rodriguez...Washington, D. C.

"Bacillus Acidophilus and Dental Caries"
By Philip Jay.....Rochester, N. Y.

"Clinical and Laboratory Studies of Vincent's Stomatitis"
By William T. Wright.....Washington, D. C.

WEDNESDAY, OCTOBER 9

OPERATIVE DENTISTRY, MATERIA MEDICA AND THERAPEUTICS

9 a. m. to 12 m.

"Making the Most of the Roentgenogram"
By Frederick F. Molt.....Chicago, Ill.
Discussed by
DeLos L. Hill.....Atlanta, Ga.
L. R. Main.....St. Louis, Mo.

"Present Status of the Pulpless Tooth from the General Practitioner's Point of View"
By U. G. Rickert.....Ann Arbor, Mich.
Discussed by
Harry B. Johnston.....Atlanta, Ga.
Alfred Walker.....New York City

"Use of Drugs in Dentistry, with Some Consideration of Administration, Application and Limitations"
By James E. Aiguier...Philadelphia, Pa.
Discussed by
Edward Hoffmeister.....Baltimore, Md.
Ewing P. Brady.....St. Louis, Mo.

FULL DENTURE PROSTHESIS

9 a. m. to 12 m.

"Value of Tooth Forms that Differ from the Anatomic"
By George P. Brenner....Milwaukee, Wis.

Discussed by
A. K. Parks.....Montgomery, Ala.
Charles M. McNeeley...Brooklyn, N. Y.

"Impressions and Graphic Registrations of Mandibular Movements"
By George P. Phillips....Boston, Mass.
Discussed by
Rupert E. Hall.....Chicago, Ill.
F. M. Hight.....Houston, Texas

"Movements of the Mandible Not Provided for in Present-Day Articulators"
By A. H. Brown.....Denver, Colo.
Discussed by
Robert R. Gillis.....Hammond, Ind.
George Wood Clapp.....New York City

PARTIAL DENTURE PROSTHESIS

9 a. m. to 12 m.

"Preparation of Teeth for Porcelain Jacket Crowns"
By J. E. Argue.....Seattle, Wash.
Discussed by
W. D. Vehe.....Minneapolis, Minn.
Charles O. McBean..Los Angeles, Calif.

"Opening Bites"
By E. T. Tinker.....Minneapolis, Minn.
Discussed by
James A. Loughry.....Cleveland, Ohio

"Partial Dentures Using Clasp Attachments"
By Norman B. Nesbett.....Boston, Mass.
Discussed by
W. D. Tracy.....New York City

ORAL SURGERY, EXODONTIA AND ANESTHESIA

9 a. m. to 12 m.

"Root Amputation"
By Theodor Blum.....New York City
Discussed by
A. B. Vastine.....Danville, Pa.
Frederick F. Molt.....Chicago, Ill.

"Impacted or Sumberged Malposed Lower Third Molar"
By J. P. Wahl.....New Orleans, La.
Discussed by
George B. Winter.....St. Louis, Mo.
Harry Bear.....Richmond, Va.

"Anesthetics"
By J. S. Lundy (M.D.)..Rochester, Minn.
Discussed by
Roy S. Hopkinson.....Milwaukee, Wis.
J. A. Heidbrink.....Minneapolis, Minn.

ORTHODONTIA

9 a. m. to 12 m.

"Use of the Roentgen Ray in Orthodontia"
By F. M. Casto.....Cleveland, Ohio

"Oral Prophylaxis During Orthodontic Treatment"
By F. Blaine Rhobotham....Chicago, Ill.

"Some Aspects of Treatment and Retention in Adult Cases"
By Victor W. Lay.....Buffalo, N. Y.

"Interrelation of Causes, Factors and Treatment in Orthodontia"
By A. F. Jackson.....Philadelphia, Pa.

"Responsibilities of the Family Dentist and Dental Specialist"
By John A. McPhail....Cincinnati, Ohio

"Case Reports"
By Harry E. Kelsey.....Baltimore, Md.

"Malocclusions and Dental Abnormalities for the General Practitioner's Consideration"
By Fred R. Blumenthal....Boston, Mass.

PERIODONTIA

9 a. m. to 12 m.

"Practical Periodontia Problems of the General Practitioner"

"Instrumentation"
By J. D. Towner.....Memphis, Tenn.

"Occlusion"
By Paul R. Stillman.....New York City

"Postoperative Dentistry"
By W. J. Charters....Des Moines, Iowa

"Economics"
By Arthur H. Merritt....New York City

MOUTH HYGIENE AND PREVENTIVE DENTISTRY

9 a. m. to 12 m.

"Prophylaxis—The Outstanding Deficiency in Dentistry Today"
By Walter Leabo.....Shreveport, La.

"The Vindication of Prophylaxis"
By Charles F. Bödecker..New York City

"Management of the Juvenile Patient, and Treatment of the Pulpless Deciduous Tooth"
By W. C. McBride.....Detroit, Mich.

"Dental Conditions in the Schools of Philadelphia"
By J. A. Detlefson.....Philadelphia, Pa.

"Recent Investigations in Prophylactic Odontotomy by the Hyatt Study Club"
By T. P. Hyatt.....New York City

HISTOLOGY, PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY AND CHEMISTRY (RESEARCH)

9 a. m. to 12 m.

"Enamel Circulation"
By E. W. Fish.....London, England

"Histologic Studies of the Changes Associated with (a) Root Canal Treatment, (b) Traumatic Occlusion"
By Bernhard Gottlieb...Vienna, Austria
George Stein.....Vienna, Austria
Rudolf Kronfeld.....Chicago, Ill.

"Tufts and Lamellae in Their Relation to Posteruptive Form Changes in the Enamel"
By Theodore B. Beust....Louisville, Ky.

"Preliminary Report on the Influence of Syphilis on the Rate of Growth of Rabbit Incisors".
By J. L. T. Appleton, Jr.....
.....Philadelphia, Pa.
K. Polevitsky.....Philadelphia, Pa.

"Histopathologic Studies of Impacted Teeth"
By Harold G. Worman.....
.....Minneapolis, Minn.

"Innervation of the Gingivae"
By D. P. Mowry.....Quebec, Canada

OPERATIVE DENTISTRY, MATERIA MEDICA AND THERAPEUTICS

2 to 5 p. m.

"Natural Effects in Porcelain"
By E. L. Pilkington.....Detroit, Mich.
Discussed by
Edward E. Haverstick....St. Louis, Mo.
William J. Meier.....New York City

"Status and Technic of Amalgam Fillings"
By William R. Pond.....Rutland, Vt.
Discussed by
Roy J. Rinehart.....Kansas City, Mo.
Harold E. Tingley.....Boston, Mass.

"Gold Foil: A Simple Time Saving Method, Not Requiring Unusual Skill"
By R. W. Rule....San Francisco, Calif.
Discussed by
Doran S. Thorn.....Washington, D. C.
Leon R. Atwood.....Brooklyn, N. Y.

FULL DENTURE PROSTHESIS

2 to 5 p. m.

"Occlusion"
By Rupert E. Hall.....Chicago, Ill.
Discussed by
C. J. Stansbery.....Seattle, Wash.
George P. Phillips.....Boston, Mass.

"Esthetic Features of Full Denture Construction"
By F. M. Willis.....Philadelphia, Pa.
Discussed by
E. H. Bruening.....Omaha, Nebr.
J. B. LaDue.....Chicago, Ill.

"Problem of Articulation and Stabilization of Dentures"
By Georges Villain.....Paris, France
Discussed by
Oskar Solbrig.....Milwaukee, Wis.

PARTIAL DENTURE PROSTHESIS

2 to 5 p. m.

"Natural Movements of the Mandible Built into Balanced Restorative Bridgework"
By C. J. Stansbery.....Seattle, Wash.
Discussed by
Russell W. Tench.....New York City
Paul R. Stillman.....New York City

"Movable Removable Bridgework"
By S. Marshall Weaver.....
.....Cleveland, Ohio
Discussed by
Charles F. Ash.....New York City

ORAL SURGERY, EXODONTIA AND ANESTHESIA

2 to 5 p. m.

"Residual Areas of the Oral Cavity"
By M. R. Howard.....Denver, Colo.
Discussed by
George F. Seeman.....Nashville, Tenn.
E. W. Browning....Salt Lake City, Utah

"Expediency of Diagnostic and Postoperative Roentgenographic Examinations in Exodontia"
By C. O. Simpson.....St. Louis, Mo.
Discussed by
J. A. Blue.....Birmingham, Ala.
Horace M. Davis.....Baltimore, Md.

"Calcium Utilization in Disease Prevention, Including Dental Caries"
By W. A. Price.....Cleveland, Ohio
Discussed by
George C. Fahy.....New Haven, Conn.
E. C. Moravec.....Cedar Rapids, Iowa

ORTHODONTIA

2 to 5 p. m.

"General Practitioner and Patient from an Orthodontic Standpoint"
By C. Barton Addie....Philadelphia, Pa.

"Operative Dentistry During Childhood as Related to Orthodontia"
By E. F. Sullivan.....Boston, Mass.

"Esthetic and Functional Development of the Upper Lip, Together with Its Use as a Retractive Force for Displaced Anterior Teeth"
By Norris C. Leonard....Baltimore, Md.

"Orthodontia a General Practitioner Should Know"
By Walter C. Chapin....New York City

"Similarities of Malocclusion in Families"
By O. W. Brandhorst.....St. Louis, Mo.

"Relation of Rickets Prevention by Prenatal Dietary Methods to the Development of the Deciduous Teeth"
By J. Victor Greenebaum, T. K. Selkirk, A. G. Mitchell and F. S. Stillwell .....Cincinnati, Ohio

PERIODONTIA

2 to 5 p. m.

"A Consideration of Clinical Periodontia"

"What Should Be the Status of Periodontia in General Practice?"
By Sidney J. Rauh.....Cincinnati, Ohio

"How Should the General Practitioner Equip Himself for the Treatment of Periodontia?"
By Clyde C. Sherwood.....Toledo, Ohio

"Recognition of Incipient Periodontoclasia by the General Practitioner, and His Obligations Therefrom"
By Wilhelmina Yeretsky.....
.....Grand Rapids, Mich.

"Problem of the Infectious Factors in Gingivitis, and Their Relationship to the Dentist"
By Robert A. Keilty..Washington, D. C.

MOUTH HYGIENE AND PREVENTIVE DENTISTRY

2 to 5 p. m.

"Dental Service in Hospitals—Its Problems and Solutions"
By S. W. A. Franken....New York City

"What Should the Dentist Know About Nutrition, and How Should Dietetic Knowledge Be Applied in a Dental Practice?"
By Wallace Seccombe..Toronto, Canada

"Dental Health Activities in Other Fields of Health Education"
By Guy S. Millberry.....
.....San Francisco, Calif.

"The Great Need for Dental Health Education"
By William R. Davis.....Lansing, Mich.

"Oral Hygiene Truths Correlated with Results"
By Walter T. McFall...Macon, Georgia

HISTOLOGY, PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY AND CHEMISTRY (RESEARCH)

2 to 5 p. m.

Symposium on the Research Work Being Carried on at the Bureau of Standards (Washington, D. C.)

(a) "Variables in Cast Denture Construction"

(b) "Progress Report on Research on Dental Materials"

(c) "Specifications for Dental Amalgam"

(d) "Mercury Poisoning from Dental Amalgam (1. Physical Tests of Amalgam. 2. Physiologic Data)"

(e) "Minimum Requirements for Dental Investments"

(f) "Survey of Inlay Casting Technics"
By N. O. Taylor, Howard S. Berger, W. T. Sweeney, Wilmer Souder and George C. Paffenbarger

THURSDAY, OCTOBER 10

OPERATIVE DENTISTRY, MATERIA MEDICA AND THERAPEUTICS

9 a. m. to 12 m.

"A System of Cavity Preparation Which Meets the Requirements of Modern Inlay Practice"

Discussed by
H. H. Streett.....Baltimore, Md.
Emory O. West.....Des Moines, Iowa

"Control of Pain in Dentistry"
By Elmer S. Best....Minneapolis, Minn.

Discussed by
P. G. Puterbaugh.....Chicago, Ill.
Edwin A. Holbrook.....Brooklyn, N. Y.

"Hand Instrumentation for Operative Procedures"
By Finn J. Bronner.....New York City

Discussed by
C. W. Strosnider.....Columbus, Ohio
R. E. Blackwell.....Chicago, Ill.

FULL DENTURE PROSTHESIS

9 a. m. to 12 m.

"Dental Terminology Relating Especially to Prosthesis"
By Kent K. Cross.....Denver, Colo.
Discussed by
Martin Dewey.....New York City
Dayton D. Campbell...Kansas City, Mo.

"Scientific and Biologic Principles of a Scissor-Bite Denture Technic"
By B. W. Avery.....Whiting, Ind.
Discussed by
I. Lester Furnas.....Cleveland, Ohio
Harold J. Leonard.....New York City

"Mechanical and Functional Principles of a Scissor-Bite Denture Technic"
By S. K. Avery.....Whiting, Ind.
Discussed by
Victor H. Sears.....New York City
Alexander H. Paterson...Baltimore, Md.

PARTIAL DENTURE PROSTHESIS

9 a. m. to 12 m.

"Indications for Fixed Bridgework"
By L. W. Doxtater.....New York City
Discussed by
O. DeForest Davis.....Cleveland, Ohio

"Advancements in the Technology of Dental Casting Based on Cooperative Research by the National Bureau of Standards and the Weinstein Research Laboratories (1922-1928)"
By Louis J. Weinstein (Sc.D.).....
.....New York City

ORAL SURGERY, EXODONTIA AND ANESTHESIA

9 a. m. to 12 m.

"Cleft Palate and Cleft Lip"
By C. J. Lyons.....Ann Arbor, Mich.
Discussed by
W. H. G. Logan.....Chicago, Ill.
W. L. Shearer.....Omaha, Nebr.

"Maxillary Sinus"
By Howard C. Miller.....Chicago, Ill.
Discussed by
Leroy Thompson (M.D.)..Chicago, Ill.
R. Boyd Bogle.....Nashville, Tenn.

"Fractures of the Mandible"
By H. Trendley Dean.....
.....Staten Island, N. Y.
Discussed by
E. C. Hume.....Louisville, Ky.
J. P. Henahan.....Cleveland, Ohio

ORTHODONTIA

9 a. m. to 12 m.

"A Broader View of the Gnathostatic Diagnosis of Simon"
By Norman L. Hillyer..Brooklyn, N. Y.

"Orthodontic Duty of the Dentist to His Patient"
By Leuman M. Waugh..New York City

"Why and When Is Orthodontic Procedure Indicated?"
By Ernest N. Bach.....Toledo, Ohio

"What Is Orthodontia?"
By Allan G. Brodie.....Newark, N. J.

"Some Attempts at Interpreting Nature's Wishes"
By Lawrence W. Baker...Boston, Mass.

PERIODONTIA

9 a. m. to 12 m.

"Research in Periodontia"

"The Lymphatic System of the Periodontal Tissue"
By E. H. Hatton.....Chicago, Ill.

"Periodontoclasia as a Focus of Infection"
By Thomas J. Cook....Rochester, Minn.

"Effect of Faulty Diets on Tooth Development and Tooth Structure"
By H. J. Klein.....Baltimore, Md.

"Changes in Bone as Influenced by Occlusion"
By G. J. O'Neill.....Windsor, Canada

MOUTH HYGIENE AND PREVENTIVE DENTISTRY

9 a. m. to 12 m.

"Dental Health Education, Subject Matter, School Dental Clinics, Method of Procedure, and Results" (Stereopticon Lecture)
By G. T. Epling.....Welch, W. Va.

"Preventive Dentistry as Reflected in the Work of Public Schools"
By U. L. Gordy.....Chambersburg, Pa.

"Prevention as Applied to Orthodontia"
By Frank A. Delabarre....Boston, Mass.

"Serving the Child in Dentistry"
By F. E. Hogeboom..Los Angeles, Calif.

"National Oral Hygiene in Canada Through a Voluntary Organization"
By Harry S. Thomson..Toronto, Canada

HISTOLOGY, PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY AND CHEMISTRY (RESEARCH)

9 a. m. to 12 m.

"Preliminary Report on Swine Feeding Experiments"
By E. V. McCollum.....Baltimore, Md.
Paul Shipley.....Baltimore, Md.

"Teeth and Jaws of Prehistoric Man"
By Aleš Hrdlička....Washington, D. C.

"Studies of the Pathologic Changes in Pyorrhea"
By Herman Becks..San Francisco, Calif.

"Leprosy with Special Reference to Dental Service in a Leprosarium"
By Bernard M. Prejean....Carville, La.

"Clinical Experiments on the Efficacy of Ultraviolet Radiation"
By T. B. Hartzell...Minneapolis, Minn.

"Research on Subgingival Therapy"
By A. B. Vastine.....Danville, Pa.

CLINIC PROGRAM

GROUP 1: COLLEGE CLINICS

Tufts College Dental School

William Rice, Dean.

"The Correlation Between the Science and the Practice of Dentistry"
Howard M. Marjerison
A. L. Morse
Walter G. Bridge
Benjamin Spector
Charles Hatch

New York University, College of Dentistry

Marshall S. Brown, Dean.

"Steps in Gold Building"
W. H. O. McGehee

"Full Dentures"
L. G. Jordan

"Traumatic Occlusion; Instrumentation; Sodium Sulphid in Treatment (Periodontia)"
Samuel C. Miller

"Roentgenographic Diagnosis in Periodontia; Case Records; Gingival Massage"
Sidney Sorrin

"Presentation of Completed Clinical Orthodontia Cases"
Abraham Lees

"Appliance Designs and Their Application in Orthodontic Treatment"
A. L. Smith

"Cases of Unusual Interest Showing Progress of Treatment (Orthodontia)"
Samuel Hemley

"Appliance Design to Meet the Requirements Presented in Treatment (Orthodontia)"
Lawrence Kurland

University of California, College of Dentistry

Guy S. Millberry, Dean.

"Dental Anatomy Technic"
(Prepared under A. L. Flock)

"Root Canal Technic"
(Prepared under J. A. Marshall)

"Operative Technic"
(Prepared under H. H. Gale)

"Dental Ceramic Technic"
(Prepared under J. R. Gill)

"Cavity Preparation in Large Plaster Models"
Robert W. Rule

Marquette University, Dental School

Henry L. Banzhaf, Dean.

"Operative Dentistry; Dental Anatomy; Methods of Instruction"
George W. Wilson

"Dental Histology and Embryology"
Matilda Steinbrecher
William Hopkinson

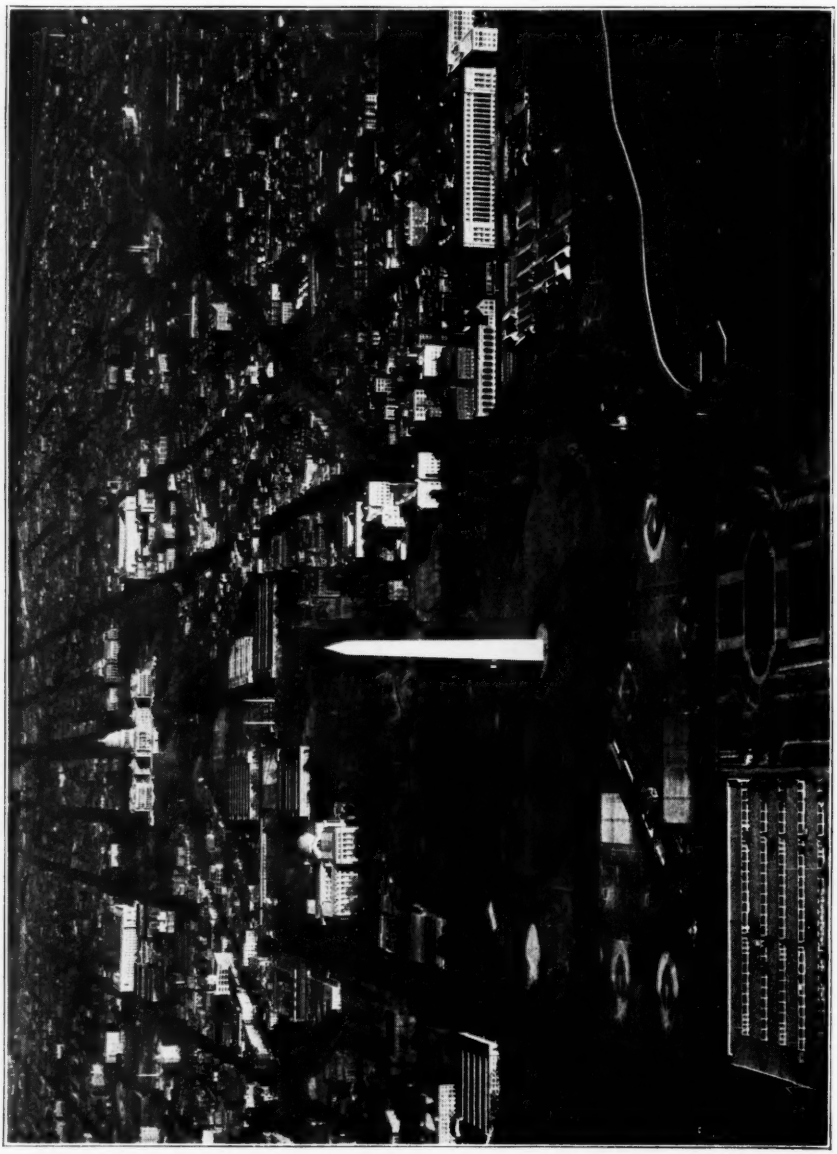
"Dental Anatomy as Taught at Marquette University"
J. H. Benson

Kansas City-Western Dental College, Lincoln and Lee University

R. J. Rinehart, Dean.

"Sequence of Steps in Full Denture Construction"
D. D. Campbell
E. L. Dillon
C. G. Porter

"Diagnostic Procedures and Roentgen-Ray Exhibitions"
R. W. Edwards



Bird's-eye view of Washington.

"Physiologically Healed Pulpless Teeth That Are More Innoxious Than Teeth with Vital Pulps, but Having Cavities or Cavity Restorations"
Edouard M. Hall

"Partial Denture Construction — One Piece Castings"
J. D. Scott

"Fixed Crowns and Bridgework"
R. J. Rinehart

Baylor University, College of Dentistry
F. W. Hinds, Dean.

"Arrangement of Teeth"
J. M. McMinn

"Crowns and Bridgework; Student and Technic Work"
F. W. Hinds

Temple University Dental School
I. N. Broomell, Dean.

"Methods of Locating Foreign Bodies in Dento-Alveolar Region"
Theodore D. Casto

"Progressive Technic in Operative Procedure"
F. S. Rusca
Louis Herman
Charles D. Sutliff

"Progressive Technic in Crowns and Bridgework"
C. Barton Addie
Rene Oldfield

"Motion Pictures Descriptive of Technical Procedure in Minor Surgery and Anesthesia"
Alfred M. Haas
E. H. Velutini
Willard S. Broomell

"Anatomic Drawings Made by Students"
Addinell Hewson

Medical College of Virginia, School of Dentistry
Harry Bear, Dean.

"Full Denture Construction"
G. W. Holliday
G. W. Duncan

"Horizontal Lingual Lock"
William B. Massey

Ohio State University, College of Dentistry
H. M. Semans, Dean.

"Pathologic Technic"
I. A. Bottenhorn

"Denture Technic"
H. V. Cottrell

"Porcelain Technic"
F. C. Starr

"Cavity Preparation Technic"
C. W. Strosnider

"Prophylactic Technic"
William C. Graham

Baltimore College of Dental Surgery, Dental School, University of Maryland
J. Ben Robinson, Dean.

"Method of Teaching Tooth Form to Students of Dental Anatomy"
Harry B. McCarthy

"Partial Impression Technic"
G. W. Gaver

"Fundamentals in Full Denture Technic for Freshman Dental Students"
W. W. Boatman

"Instruction to Students in Clinical Dentistry on Construction of Fixed Anterior Bridges to Combine Strength, Hygienic Principles and Esthetics"
George S. Koshi

"Demonstration Equipment for Instruction to Dental Students of Orthodontia"
G. A. Devlin
George M. Anderson

"Demonstrating Work in Crown and Bridge Technic Done by Dental Students"
W. L. Oggesen

Georgetown University, Dental Department
W. N. Cogan, Dean.

"Dental Anatomy (Technic of Preparation of Partial Dentures)"
E. J. Botazzi

"Preoperative and Postoperative Models for Cases of Alveolectomy; Aluminum Base Plate; Method of Improving Esthetics in Full Denture Construction"
William F. Colliton

"Practical Orthodontia Cases"
S. C. Hopkins

"Crowns and Bridgework"
Nathan Cone

"Bacteriology and Pathology"
J. B. Lutz

"Anesthesia"
Daniel F. Lynch

"Anatomic Specimens"
J. P. Madigan (M.D.)

Bird's-eye view of Washington.

"Oral Surgery; Physiotheraphy in Dentistry; Exodontia Technic"
Sterling V. Mead

"Operative Technic"
A. G. Miller

"Diseases of the Mouth"
Howard J. Newton

"Teaching Model of Maxillary and Mandibular Teeth"
Doran S. Thorn

"Cases for Cooperation Between Rhinologist and Dental Surgeon"
G. B. Trible (M.D.)

Northwestern University Dental School
Arthur D. Black, Dean.

"Simplified Technic for Pulp Removal, and Some of Its Problems"
Harold G. Ray

"Effects on Occlusion of Congenital Absence or Premature Extraction of Teeth"
James J. Guerrero

"Simplified Method of Wax Adaptation in Inlay Construction"
Clarence H. Burr

"Extention for Prevention in Inlay Abutments for Fixed Bridgework"
O. W. Silberhorn

Forsyth Dental Infirmary, Boston, Mass.

"Demonstration of Tissue Changes Following Certain Food Changes"
Ruth E. Hatch (B.A.)

"Methods of Dietetic Instruction as Employed at Forsyth Dental Infirmary"
Ruth L. White (B.S.)

"Exposition of Clinical Procedures for Children"
Paul K. Losch

"Preparation and Use of Silver Reduction Solutions"
Milan A. Logan (Ph.D.)

GROUP 2: SECTION CLINICS

Operative Dentistry, Materia Medica and Therapeutics

"Gold Foil Operation with a Combination of Noncohesive and Cohesive Gold, Demonstrating Ease and Rapidity of Placing Foil"
Robert W. Rule....San Francisco, Calif.

"New System of Hand Instrumentation Based on Mechanical Laws"
Finn J. Bronner.....New York City

"Natural Effects in Porcelain"
Ernest L. Pilkington.....Detroit, Mich.

"Wax Pattern Investment, Elimination and Casting Gold Inlays"
Emory O. West.....Des Moines, Iowa

"Jacket Crown Preparation Using Jigger Files for Finishing Shoulder. Taking Impression of Same and Mounting on Artificial Root Ends"
William J. Meier.....New York City

"Impression and Bite Taking for the Various Types of Cavities by the Indirect System"
Albert J. Irving.....New York City

"Wax Expansion and Steam Elimination Inlay Technic"
F. S. Meyer.....Minneapolis, Minn.

"Amalgam Restorations"
William R. Pond.....Rutland, Vt.

Full Denture Prosthesis

"Lower Denture from Impression to Service, Stressing Some Fundamentals That Have Been Overlooked"
John G. Logan.....Portage, Pa.

"Graphic Registration of Mandibular Movements"
George P. Phillips.....Boston, Mass.

"Esthetic Features in Full Denture Construction"
F. M. Willis.....Philadelphia, Pa.

"Requirements of a Truly Adaptable Articulator"
A. H. Brown.....Denver, Colo.

"Milling Articulator, a Simplified Means of Obtaining Functional Occlusion"
R. W. Burch.....Fort Lauderdale, Fla.

Partial Denture Prosthesis

"Direct Gold Inlay"
George M. Hollenbach.....
.....Los Angeles, Calif.

"Preparation of Teeth for Porcelain Crown"
J. E. Argue.....Seattle, Wash.

"Study in Clasp Bridge Construction"
William J. Hoag.....New York City

"Check on Some of the Variables in Partial Denture Construction"
Norman B. Nesbett.....Boston, Mass.

"Crowns and Bridgework"
L. W. Doxtater.....New York City

"Round Wire Clasp Design"
Leo Gordon Pollock.....New York City

"Problems of Occlusion as Related to Partial Denture Construction"
Victor H. Sears.....New York City

"Thimble Jacket Crown: A New Modification of the Porcelain Jacket, and Its Place as an Abutment in All Types of Bridgework"
Ferdinand G. Neurohr...New York City

Oral Surgery, Exodontia and Anesthesia

"Nitrous Oxid, Oxygen, Carbon Dioxid Anesthesia, and Extraction of Teeth, Shown by Moving Pictures of Practical Cases"
J. A. Heidbrink.....Minneapolis, Minn.

Periodontia

"Prosthetic Dentistry"
Edward Kennedy.....New York City

"Periodontoclasia as a Focus of Infection"
Thomas J. Cook.....Rochester, Minn.

"Operative Dentistry"
LeRoy L. Hartman.....New York City

"Postoperative Dentistry"
W. J. Charters.....Des Moines, Iowa

"Recognition of Incipient Periodontoclasia by the General Practitioner, and His Obligation Therefrom"
Wilhelmina Yeretsky.....Detroit, Mich.

"How Should the General Practitioner Equip Himself for the Treatment of Periodontia?"
Clyde C. Sherwood.....Toledo, Ohio

"Changes in Bone as Influenced by Occlusion"
G. J. O'Neill.....Windsor, Canada

Orthodontia

"Use of Bite Plane in Older Patients"
Oren A. Oliver.....Nashville, Tenn.

"Appliance Design in Light Resilient Arch Assemblage"
Edward M. Griffin.....New York City

"Cases Illustrating Importance of Cooperation Between Family Dentist and Orthodontist"
John A. McPhail.....Cincinnati, Ohio

"Orthodontia as It Applies to the General Practitioner"
J. L. Selden.....Louisville, Ky.

"Presentation of Several Series of Models of Deciduous Teeth, Showing Self Correction of Malocclusion Caused by Thumb Sucking"
Samuel J. Lewis.....Detroit, Mich.

"Orthodontia"
Russell E. Irish.....Pittsburgh, Pa.

"Value of an Articulator in Preparing Appliances for Certain Orthodontic Cases"
Victor W. Lay.....Buffalo, N. Y.

Technic Steps in the Use of the Newest Angle Mechanism

1. "Application of Staples and Manipulation of Ligatures"
Allan G. Brodie.....Newark, N. J.
2. "Band Forming"
Walter M. Dunlap..East Orange, N. J.
3. "Ideal Arch-Forming"
Edward J. Gromme..Cincinnati, Ohio

"Orthodontic Attachments for Unerupted Teeth"
Harris W. McClain.....Chicago, Ill.

"New Methods and Compositions for Accurate Facial Casts and Orthodontic Impressions"
E. H. Golden.....St. Louis, Mo.

"Preventive Orthodontia"
Howard A. Denbo.....Chicago, Ill.

"Results of Premature Loss of Deciduous Teeth"
Frederick R. Stathers..Philadelphia, Pa.

"Possibilities and Limitations of Orthodontia in the Prevention of Periodontal Disease"
John Oppie McCall and
Egon Neustadt.....New York City

Mouth Hygiene and Preventive Dentistry

Thaddeus P. Hyatt Study Club, New York City

"Histology. Pre-carious Pits and Fissures"
M. Diamond.....New York City
Bernard Clug.....New York City

"Instruments for Examination"
Arthur M. Hunter and T. P. Hyatt, Jr.
.....New York City

"Cavity Preparation"
T. O. Peterson and Shirley H. Dwyer
.....Brooklyn, N. Y.

"Temporary Treatment"
J. H. Kauffman and Oscar J. Chase
.....New York City

"Permanent Filling Restorations"
W. N. Fraser.....Brooklyn, N. Y.
W. B. Dunning.....New York City

GROUP 3: STATE ASSOCIATION INDIVIDUAL CLINICS

Alabama

"Conservative Surgical Treatment of Advanced Periodontal Lesions"
Olin Kirkland.....Montgomery

"Cohesive and Noncohesive Gold Foil Fillings"
H. B. Peacock.....Opelika

"Surgical Preparation of Mouths for Dentures; Surgical Removal of Teeth"
James A. Blue.....Birmingham

"Roentgen-Ray Technic"
Charles F. Chandler.....Montgomery

Arkansas

"Modified Technic for Inlay Abutment Preparations in Fixed Bridgework"
J. O. Hall.....Little Rock

"Maintenance of Health in Oral Cavity"
Rowe Smith.....Texarkana

California State

"Dentistry for Children"
John E. Gurley.....San Francisco

California (Southern)

"Reconstruction of Occlusion" (Illustrated by moving pictures)
E. Ray Brownson.....Los Angeles

Colorado

"Wax Models of Practical Cases in Dental Oral Surgery"
W. W. Cogswell.....Colorado Springs

Connecticut

"Working Classification in Partial Denture Restorations"
Charles M. Bailyn.....Hartford

"Erosions of Teeth and Their Treatment"
Jewell M. Gompertz.....New Haven

"Roentgenograms Showing Radium Necrosis"
Arthur B. Holmes.....Waterbury

"Hydrogen Ion Concentration of Saliva: Accurate Test at Chair for Acidity or Alkalinity"
Louis R. Gans.....New Haven

Florida

"Table Clinic on Radiodontia"
J. H. Shaw.....St. Petersburg

"Comparison of Tooth Form to the Supporting Tissue in Denture Construction"
A. W. Sears.....Jacksonville

"Modern Operative Dental Practice"
K. G. Knoche.....Jacksonville

"Effective Method of Root Canal Technic"
G. M. Shields.....Miami

Georgia

"Correlating Preaching and Practice in Children's Dentistry"
Walter T. McFall.....Macon

"Porcelain Inlays and Jacket Crowns; A Practical and Dependable Technic"
M. D. Huff.....Atlanta

"Exodontia and Oral Surgery"
Thomas Conner.....Atlanta

Illinois

"Conservation of Time and Tooth Structure in Gold Inlay Work, and Construction of Esthetic Attachments in Fixed Bridge Work"
P. A. Pyper.....Pontiac

"Impressions for Full Dentures"
K. F. Knudtzon.....Chicago

"Conservation of First Permanent Molar by Use of Copper Cement and Carbol Eugenol"
C. Carroll Smith.....Peoria

"Impressions for Full Dentures"
E. C. Pendleton.....Chicago

"Full Dentures"
Charles J. Sowle.....Rockford

"Some Helpful Hints in Exodontia"
J. C. Murdoch.....Peoria

"Exodontia"
E. L. Dunn.....Chicago

"Bite Wing Films for Locating Hidden Caries"
Benjamin S. Partridge.....Chicago

"Cast Gold Inlays"
A. P. Grunn.....Chicago

"Silver Nitrate Reduction as Applied to Root Canals, Infected Dentin, Etc."
Victor H. Fuqua.....Chicago

"Oral Diagnosis Procedures"
Paul G. Lilja.....Chicago

"Rustless Steel as a Base for Artificial Dentures"
W. F. Schmeckebier.....Evanston

"Root Canal Technic Using Dentinoid and Lead Points"
Elbert W. King.....Geneseo

"Therapeutic Procedure for Deciduous Teeth"
Elsie Gerlach.....Chicago

"Indications for Silicates"
D. N. Lewis.....Lake Forest

"Prophylactic Odontotomy"
E. J. Ryan.....Chicago

"Removal of Impacted Teeth Under Procain Anesthesia"
P. G. Puterbaugh.....Chicago

"Cavity Preparation"
Victor T. Nylander.....Chicago

"Synthetic Technic as Applied in Every Day Practice"
E. I. Herzberg.....Chicago

"Fixed Bridgework Featuring Use of Porcelain"
G. Arthur Nelson.....Chicago

"Partial Dentures and Removal Bridges"
Raymond M. Bondy.....Chicago

"Filling of Pulp Canals"
Earl P. Boulger.....Chicago

Indiana

"Setting Up Full Denture"
Robert R. Gillis.....Hammond

"New Method for Full Upper and Lower Impressions and Rebasing of Full Dentures"
N. G. Willis.....Connersville

Iowa

"Porcelain Jacket Crowns and Inlays"
E. W. Howard.....Des Moines

"Porcelain Veneer Crowns"
S. F. Holaday.....Webster City

"Theory, Articulators, Practice"
William A. Sharp.....Des Moines

"Report of Case Showing the Absence of Enamel Formation, Giving the Case History and Presenting Roentgenograms and Models"
Leland E. Weyer.....Cedar Rapids

Kentucky

"Malignancies as Seen by Dentist"
C. J. Hudson.....Covington

"Preventive Treatment for Dental Caries" (Illustrated)
H. K. Kellogg.....Louisville

"How to Obtain Balanced Occlusion"
A. E. Lang.....Russell

Massachusetts

"Amalgam Technic"
Frederick G. Jellison.....Georgetown

"Dental Economics"
Edwin N. Kent.....Boston

"Some Instruments and Methods Used in Exodontia"
J. Campbell Thompson.....Boston

"Dental Economics"
Glenn W. Lawrence.....Boston

"Some Factors in Pulp Protection Through Sterilization and Cavity Lining"
John W. Cooke.....Boston

"Postoperative Sterilization of Root Ends by Silver Nitrate—Ammoniacal Precipitation" Following Apicoectomy
C. M. Proctor.....Boston

"Microscopic Study of Infected Tooth Tissue
R. R. Davenport.....Boston

"Sterilization of Root Canals with Silver Nitrate"
J. P. Herlihy.....Boston

"Gold Foil"
Martin J. Daley.....Dorchester

"Preparation and Filling of Cervical Cavity with Gold Foil"
Leon E. Dulac.....Cambridge

Michigan

"Children's Dentistry"
Samuel D. Harris.....Detroit

"Mouth Disease and Oral Diagnosis"
M. Rattner.....Detroit

"Removable Bridgework with Bar Clasps"
Richard C. Gorman.....Detroit

"Dental Economics"
W. N. Miller.....Flint

Minnesota

"Diseases of Soft and Hard Tissues of Oral Cavity as They Relate to Systemic Conditions"
William A. Grey.....St. Paul

"Utilizing Mechanical Accuracy in Standardizing Root Canal Surgery"
Carl J. Grove.....St. Paul

"Experiences with Bite-Wing Films"
Henry A. Holmberg.....St. Paul

"Oral Tumors"
Carl W. Waldron.....Minneapolis

"Postoperative Treatment of Pyorrhea"
Thomas B. Hartzell.....Minneapolis

"Establishment of Centric Relation; Full Dentures"
R. G. Keyworth.....St. Paul

Mississippi

"Direct-Indirect Making of Inlays—Amalgam Dies"
R. S. Neyland.....Jackson

"Profile Facial Measurement as an Aid in Establishing and Maintaining Proper Relation of Jaws in Prosthetic Restorations (Some Practical Points and Appliances)"
C. A. Moore.....Lexington

"Surgical Extraction and Removal of Infection with Least Amount of Trauma"
Rush P. Abbott.....West Point

"Accurate Emergency Trial Plates Not Requiring Construction on Models"
H. D. Chipps.....Corinth

Missouri

"Esthetic Pontics with Porcelain Gingival Extention"
E. E. Haverstick.....St. Louis

"Removable Bridgework, One Casting, Featuring Replacing All Lost Teeth Distad from Cuspids"
Charles P. Crosby.....St. Louis

"Root Canal Technic"
Ewing P. Brady.....St. Louis

"Diseases of Gums, Jawbones and Mouth"
Hubert McP. Hutton.....Kansas City

Montana

"Miscellaneous Ideas from Montana: A Collection of Helps for the General Practitioner"
T. P. Regan.....Helena

New York

"Pinledge Attachment"
James Kendall Burgess..New York City

"Ultraviolet Rays in Dentistry"
C. Raymond Wells.....Brooklyn

"Silicates and Their Manipulation"
E. J. C. Smith.Westhampton Beach, N. Y.

"Substituting Cement for Dentin, Eliminating Undercuts, Strengthening Cavity Walls and Making Ideal Form"
R. H. Reese.....Brooklyn

"General Anesthesia in Dentistry"
Harry M. Seldin.....New York City

"Partial Denture Design Giving Thought to Minimizing of Stresses Upon Abutment Teeth; Equalization of Stresses Between Teeth and Tissues, and Maintenance of Occlusal Harmony as Established"
Clyde H. Schuyler.....New York City

"Matrix Cast Base Porcelain Crown and Matrix Cast Gold Crown"
John T. Knox.....New York City

"Abutment Preparations; Abutments and Pontics for Fixed Bridgework; Anatomic Restorations and Carvings in Ivory, Wax and Plaster"
J. R. Schwartz.....Brooklyn

"A Method of Root Treatment with Silver Nitrate"
Edbert A. Smith.....New York City

"Occlusion as the Determining Factor in All Dental Restorations. Occluso-Symmetrograph as a Guide to Proper Occlusion for the Orthodontist, Prosthodontist and Periodontist"
Victor Stoll.....New York City

"Standardized Technic for Dental Roentgenography"
R. H. Burkhart.....New York City

"Diseases of Tongue: Consideration of Precancerous Factors" (Illustrated in natural colors)
Arthur J. Barsky.....New York City

"Silicate Restorations"
Morris Schoenfeld.....New York City

"Removable Bridgework and Porcelain Restorations (1. Continuous Gum Full Denture. 2. Continuous Gum Removable Bridge. 3. Porcelain Jacket Crown. 4. Porcelain Inlay. 5. Use of Stains)"
Milton Cohen.....New York City

"Dental Economics; Some Elements in the Cost of Dental Service" (Illustrated with charts)
George Wood Clapp.....New York City

"Mechanical Restorations for Congenital Cleft Palate" (Presentation of cases showing results)
Vethake E. Mitchell.....New York City

"Dynamic Bite and Its Practical Application"
David S. Highkin.....New York City

"Oral Surgery for General Practitioner"
D. B. Parker.....New York City

"Casting Technic"
W. H. Crawford.....New York City

"Oral Diagnosis"
H. J. Leonard.....New York City

"Oral Diagnosis"
H. Holliday.....New York City

North Carolina

"Channel Teeth (Practical Case)"
Lucian G. Coble.....Greensboro

North Dakota

"Immediate Replacement of Teeth, and Use of Condensite Base"
W. E. Hocking.....Devils Lake

Ohio

"An Intra-Oral Unicontact Device for Making and Registering Occlusion"
L. Langdon Sheffield.....Toledo

"The Use of Gelatin in Dental Arts (Partial and Full Denture Construction)"
J. V. Gentilly.....Cleveland

"A Study in Dental Roentgenograms"
Earle S. Braithwaite.....Willard

"Fixed Bridges with Rest Abutments"
Harry H. McUmber.....Toledo

"Treatment of Deep Seated Cavities and Exposed Pulps"
A. E. Mann.....Findlay

Oklahoma

"Functional Checkbite, Establishing Centric Relation. Transfer to Anatomic Articulator"
George W. Andree.....Tishomingo

"A Frank Exposition of Pyorrhea Problems"
E. L. Miley.....Oklahoma City

Oregon

"Orthodontia"
C. H. Walrath.....Portland

"Roentgenography—Interpretation and Diagnosis"
H. C. Fixott.....Portland

Pennsylvania

"Sterilization of Cavities, and Detection of Decay with Ammonical Silver-Nitrate and Solution of Formaldehyd; Removal of Stain"
William W. Booth.....Pittsburgh

"Filling Porcelains"
Joseph E. Echternach.....Philadelphia

Tennessee

"Original Helps"
M. B. Carter.....Franklin

Virginia

"Amalgam Technic; Consideration of Anatomy of Bicuspid and Molar Teeth"
Herbert Cohn.....Richmond

West Virginia

"Handling of Children with Acutely Abscessed Teeth"
L. A. Stark.....Clarksburg

"Demonstration of Methods and Equipment Used in Conducting Dental Clinics in Rural Schools"
G. T. Epling.....Welch

GROUP 4: STATE ASSOCIATION GROUP CLINICS

Florida

"Porcelain Pontic Bridgework Using Pinlays, Inlays and Three-Quarter Crowns and Abutments"
L. D. Pankey.....Coral Gables
E. B. Penn.....Miami
W. G. Sanchez.....Miami

Illinois

"Root Canal Therapy (a) Mechanical Procedures in Exposing Pulp Chamber, Curetting and Enlarging Root Canals. (b) Exhibit Showing Clinical Results of Pulp Canal Treatment. (c) Exhibit Showing Tissue Reactions Which Occur in Apical Region After Pulp Treatment"
J. R. Blayney.....Chicago
Otto Litwiller.....Peoria
Homer Peer.....Urbana

"Casting Technic"
F. Ewing Roach, William I. McNeil, G. Walter Dittmar and Joseph G. Wiedder.....Chicago

Iowa

"A Technic for Gold Casting"
Des Moines Research Club
H. B. Haselton, Chairman
E. H. Ford
D. D. Drake
H. A. Anderson

Indiana

"Sources of Errors and Their Correction in Making Cast Inlays and Crowns"
Allen L. Voiers.....Jeffersonville
M. E. Peck.....Jeffersonville

Massachusetts

"Indirect Inlay Technic as Applied to Modern Office Practice"
Worcester Study Club
Leon A. Storz, Director

Charles E. Faulkner, Jr., Instructor
Rudolph A. Hagberg, Secretary
Malcolm W. Atkins
Lindale C. Davies
Harold G. Ekdahl
Frank C. Martin
Elmer T. Nordlander
John A. Tessmer

Michigan

"Dental Economics"
M. R. Clinton, A. W. Squires and G. E. Madison.....Detroit

"Dimensional Casting"
R. K. Brown and D. C. Winans
.....Ann Arbor

"Group Practice and Twenty Years After; (Records of Cases, Models, Roentgenograms, Etc.; Bookkeeping System; Records Showing Durability of Work and Cost of Same to Patients Over a Period of Twenty Years)"
L. G. Bailey and W. E. Bailey..Lansing

Minnesota

"Children's Dentistry; Diagnosis, Operative Procedure, Results"
Thomas P. Ryan, Chairman.Minneapolis

"Space Retention and Restoration of Function"
R. L. Dunton.....Minneapolis

"Handling of Children"
T. J. Mee.....Minneapolis

"Precaution in Care of Permanent Teeth"
Fred C. Obermeyer.....Minneapolis

"Extraction of Children's Teeth"
George L. Kline.....Minneapolis

"Filling Deciduous Teeth" (Prepared by K. W. Miner, Minneapolis)
M. P. Feigal.....Morton

New York

Full Denture Construction
Buffalo Prosthetic Club

"Anatomy and Impressions"
E. L. Ruffing

"Jaw Relations"
E. B. Darling

"Selection and Arrangement of Teeth"
H. E. Reynolds

"Correction Technic"
H. T. Gallagher

New York Group

Root Canal Therapy

"Diagnosis and Selection of Cases: Simple Method for Bacteriologic Control in Putrescent Cases"
Nathaniel Freeman

"Asepsis; Standardization; Methods for Devitalization"
Jacob B. Schneer

"Surgical and Mechanical Cleaning of Pulp Canals"
E. Allen Lieban

"Management of Infected Teeth and Periapical Areas (Ionization, Indications and Contraindications for Apiectomy)"
Alfred Walker

"Filling Canals: Demonstrat'on on Teeth Models and Charts"
E. G. Van Valey

"Skin Test to Determine Degree of Inflammatory Reaction to Organisms Found in Dental Infection"
Herman J. Kauffer

New York Amalgam Group Clinic

John T. Hanks
Waldo H. Mork
F. A. Stewart, Jr.
Marcus Lee
Frank G. Nellis (Brooklyn)

Oklahoma

"Helpful Hints in Bridgework"
A. F. Sebert and L. E. Church...Clinton

Pennsylvania

The Dental Clinic Club of Philadelphia

"Orthodontia"
Andrew F. Jackson
John W. Ross
Harry B. Wright

"Operative Dentistry"
S. Blair Luckie (Chester)
Gustave C. Tassman

"Pulp Conservation and Root Canal Therapy"
Andrew J. Seeler
James I. Woolverton (Trenton, N. J.)

"Periodontoclasia"
John H. Greene
A. L. Orr
Herbert L. Fischer

"Roentgenography"
LeRoy M. Ennis
Mugur Hagopian
Charles A. Bogart (Chester)

"Oral Surgery"
Robert H. Ivy

"Local Anesthesia"
James E. Aiguier
John H. Gunter

"Exodontia"
L. B. Duffield
George C. Davis
David C. Turkington (Chester)
William J. Asprey (Norwood)

"Inlay, Crown and Bridge Restorations"
W. J. Robinson
Aleyas Kassab (Chester)
E. A. Manning (Chester)
Lyman Messimer

"Partial Denture Construction"
Frank A. Fox
Rupert G. Beale
Hugh McWilliams
A. L. Mulford

"Ceramics"
W. W. Powell
Raymond S. Clarke (Mt. Holly, N. J.)
Paul Simonsen
E. Carlton Palmer

"Full Dentures"
Edward B. Dewhurst
M. M. DeVan
Benjamin Benedict

Tennessee

"Restoring to Proper Condition a Mouth Incapable of Functioning Normally"
F. H. Hall and C. W. Hoffer..Nashville

"Two Types of Fixed Restorations"
Edward F. Huckaba and T. E. Braly
..... Chattanooga

GROUP 5: FOREIGN CLINICS

"Automatic Articulation and Stabilization of Dentures"
Georges Villain.....Paris, France

"Innervation of Gingivae"
D. P. Mowry.....Montreal, Canada

GROUP 6: FOURTH DISTRICT CLINIC PROGRAM

"Practical Surgery Problems" (demonstrated at a hospital in Washington, D. C.)
Oral Surgeons of Washington, D. C.

"Preparation of Three-Quarter Crown from Cavity Preparation to Finished Castings"
M. M. Dolmage, E. J. Copping, S. L. Bogdonoff, D. J. O'Donnell and J. K. Jennings.....Washington, D. C.

"Condensation of Porcelain"
S. D. Gottlieb.....Washington, D. C.

"Cast Base for Gold Dentures"
S. S. Jaffe.....Washington, D. C.

"Some Phase of Partial Denture Construction"
Alexander Chase....Washington, D. C.

"Report of Committee Working on Amalgam with Bureau of Standards"
W. M. Simkins, Chairman, and J. W. Brown .....Washington, D. C.

"Metaphen Treatment for Control of Dental Caries"
Bruce L. Taylor.....Washington, D. C.

"A Molar Band Technic"
W. Paul Hoffman....Washington, D. C.

"Porcelain Inlays"
L. J. Brodsky.....Washington, D. C.

"Additional Roentgen-Ray Films in Routine Diagnosis"
William I. Ogus.....Washington, D. C.

"Correction of Full Dentures"
Carl J. Mess.....Washington, D. C.

"Residual Areas in Edentulous Cases"
W. S. Benedict.....Washington, D. C.

"Porcelain Pontics"
Charles B. Keefer....Washington, D. C.

"Pinledge Attachments; Attachments and Pinlays"
K. P. Hintz, A. P. Dixon and W. E. Kolb .....Cumberland, Md.

"Periodontal Pocket"
Leo Walzak.....Baltimore, Md.

"Root Canal Therapy and Roentgenographic Review Before and After Treatment"
H. H. Streett.....Baltimore, Md.

"Roentgenographic Diagnosis and Fractures"
A. Y. Russell.....Baltimore, Md.

"Cast Base—Davis Crown"
J. Ben Robinson.....Baltimore, Md.

"Models Illustrating Retentive Aids in Full and Partial Denture; Models Illustrating Finished Impression Taking Advantage of Retentive Aids"
Alexander H. Paterson...Baltimore, Md.

"Examination and Charting"
Jesse S. Myers.....Baltimore, Md.

"Root Canal Work"
D. B. Lancaster.....Baltimore, Md.

"Study of a Few Preliminary Impressions and Bite Steps in Full Denture Work"
Thomas H. Litz.....Baltimore, Md.

"Some Orthodontic Suggestions"
Norris C. Leonard.....Baltimore, Md.

"Technic of Extra-Oral Injection"
Emanuel Kreiger.....Baltimore, Md.

"Various Forms and Uses of the Bite Plane; Locking Device for Lingual or Labial Arches; Appliance for Closing Spaces Caused by Loss of One or More Teeth"
Harry E. Kelsey.....Baltimore, Md.

"Practical Anatomy Demonstration with Wet Specimen"
E. E. Hackman.....Baltimore, Md.

"Round Wire Removable Bridge"
Raymond L. Hughes....Baltimore, Md.

"National Effective Treatment for Vincent's Disease"
Hugh T. Hicks.....Baltimore, Md.

"All Porcelain Bridge Pontic"
George E. Hardy, Jr.....Baltimore, Md.

"Inlay Technic: Preparation; Manipulation of Wax; Direct Method" (Chair clinic)
F. J. Ellison.....Baltimore, Md.

"Medicodental Cases of Interest to the Dentist"
Horace M. Davis and William B. Lauten .....Baltimore, Md.

"Controlling Variables in Casting"
O. E. Culler.....Baltimore, Md.
L. L. Brown.....Ellicott City, Md.

"Miniature Sculpture in Black Dental Inlay Wax"
J. P. Bell.....Baltimore, Md.

"Restoration of Porcelain Tooth on Badly Broken Down Devitalized Posterior Tooth Having Widely Divergent Root Canals"
W. H. Baish and E. L. Baish
.....Baltimore, Md.

"Preparation for Porcelain Jacket Crown"
Charles R. Jeffries, Jr..Wilmington, Del.

"Cavity Preparation and Burnishing Matrix for Porcelain Inlay"
Robert E. Price.....Wilmington, Del.

"Restoration of Occlusal Forms in Amalgam Fillings"
J. Paul Wintrup.....Wilmington, Del.
Clyde A. Nelson.....Milford, Del.

"Full Dentures"
A. A. Harrington.....Newark, N. J.

"Cast Porcelain"
Curt O. H. Kayser.....Princeton, N. J.

"Swaged Root Cap Technic"
George Strausberg.....Newark, N. J.

"Standardized Procedure for the Control and Eradication of Periodontal Disease (Pyorrhea, Vincent's Infection, Gingivitis)"
I. Miller.....Jersey City, N. J.

"Wax Rebasing for Full Dentures"
Ernest C. Reock.....Belleville, N. J.

"Periodontia"
Joseph R. Walsh.....Newark, N. J.

"Gold Inlays"
Robert E. Dorr.....East Orange, N. J.

"Pinledge Abutments"
Edward B. Gibbins.....Newark, N. J.

"Ideal Restoration of a Lost Anterior Tooth"
Leon H. Fradkin.....Montclair, N. J.

"Root Canal Therapy"
Sidney S. Jedel.....Newark, N. J.

"Dry Socket"
Morris A. Zimmer.....Newark, N. J.

"Conduction Anesthesia"
Ernest Webster.....East Orange, N. J.

"Simple, Practical, Dependable Method of Making Pinledge Abutments; Cast Direct"
Walter Schilke.....Englewood, N. J.

"Gold Inlay Technic"
Jacob Schaffer.....Newark, N. J.

"Gold Inlay Bridges"
Robert J. Lohrmann..East Orange, N. J.

"Alloy Restorations"
C. W. Gray and Anton J. Krebs....
.....Newark, N. J.

"Full Dentures"
Frederic B. Kremer....Irvington, N. J.

"Full Dentures" (Progressive clinic)
Charles F. Harper, Francis J. Houghton, Phillip Nemhoff and Jerome D. Schwarz
.....Jersey City, N. J.

"Root Canal Technic"
Adam Glutting.....Newark, N. J.

"Importance of Dental Records"
Hugh F. Fox.....Newark, N. J.

"Pathologic Prosthesis"
Elvin F. Axt.....Maplewood, N. J.

"A Silver Nitrate Treatment"
G. E. Cleary.....Elizabeth, N. J.

"Exodontia"
A. Irwin.....Philadelphia, Pa.

"Minor Surgery for the Dentist"
A. F. Gorham.....Camden, N. J.
"Drugs and Their Uses"
W. E. Van Erde.....Camden, N. J.
"Roentgenology for the General Practitioner"
L. M. Kitarian.....Camden, N. J.
"Cavity Preparation for Gold Inlays"
Benjamin Vine.....Trenton, N. J.
"Surgical Preparation of the Mouth for Immediate Insertion of Dentures"
J. A. Flood.....Trenton, N. J.
"Roentgenographic Aids to Exodontia"
E. H. Brown.....Trenton, N. J.
"Identification by Naval Records"
Ralph W. Malone....Washington, D. C.
"Oral Diagnosis"
C. V. Rault.....Washington, D. C.
"Small Nontapering Screw"
John V. McAlpin.....Washington, D. C.
"Porcelain Inlay"
William W. Marr...Washington, D. C.
"Fractures"
W. D. Lanier.....Bronx, N. Y.
"Resorption Due to Leprosy"
Bernard M. Prejean.....Carville, La.
"Fractures of the Mandible"
H. Trendley Dean..Staten Island, N. Y.
"Vincent's Infection"
William T. Wright.....Baltimore, Md.
"Some Phases of Periodontia"
Lynn H. Tingay.....Washington, D. C.
"Partial Denture Prosthesis"
Roy Bodine.....Washington, D. C.
"Bacteriology"
F. E. Rodriguez.....Washington, D. C.
"Intermaxillary Wiring"
John L. Schock.....Washington, D. C.
"Extraction Problem in Orthodontia"
N. A. Harper.....Washington, D. C.
"Tendencies in Present Day Bridge Construction"
V. V. Bele.....Washington, D. C.

THE WASHINGTON SESSION

SCIENTIFIC EXHIBITS

1. "Histopathologic Exhibit of Mouth Lesions" (Charts)
   Lester R. Cahn, Department of Oral Pathology, Columbia University Dental School.
2. "Diseases of the Mouth Demonstrated in Wax Models of Natural Color"
   Joseph Schroff, Department of Oral Pathology, Columbia University Dental School.
3. "Oral Histology and Pathology of Animal Jaws"
   Herman Becks, University of California, School of Dentistry.
4. "Comparative Anatomy"
   Theodore B. Beust, University of Louisville, School of Dentistry.
5. "Exhibit of Microphotographs"
   William G. Skillen, Northwestern University Dental School.

MOTION PICTURE PROGRAM

On Tuesday, Wednesday and Thursday, motion pictures on the care of the mouth and teeth will be exhibited at the Washington Auditorium for a large part of each day to several thousand children, whose attendance will be arranged as a part of their school curriculum. This is a new feature which will in no way interfere with the regular attendance of adults as at former conventions.

LUNCH CLUB PROGRAM

Monday, October 7

Caravan Club, 12:30 p. m., Raleigh Hotel.
Newcomers Club, 12:30 p. m., Lafayette Hotel.

Tuesday, October 8

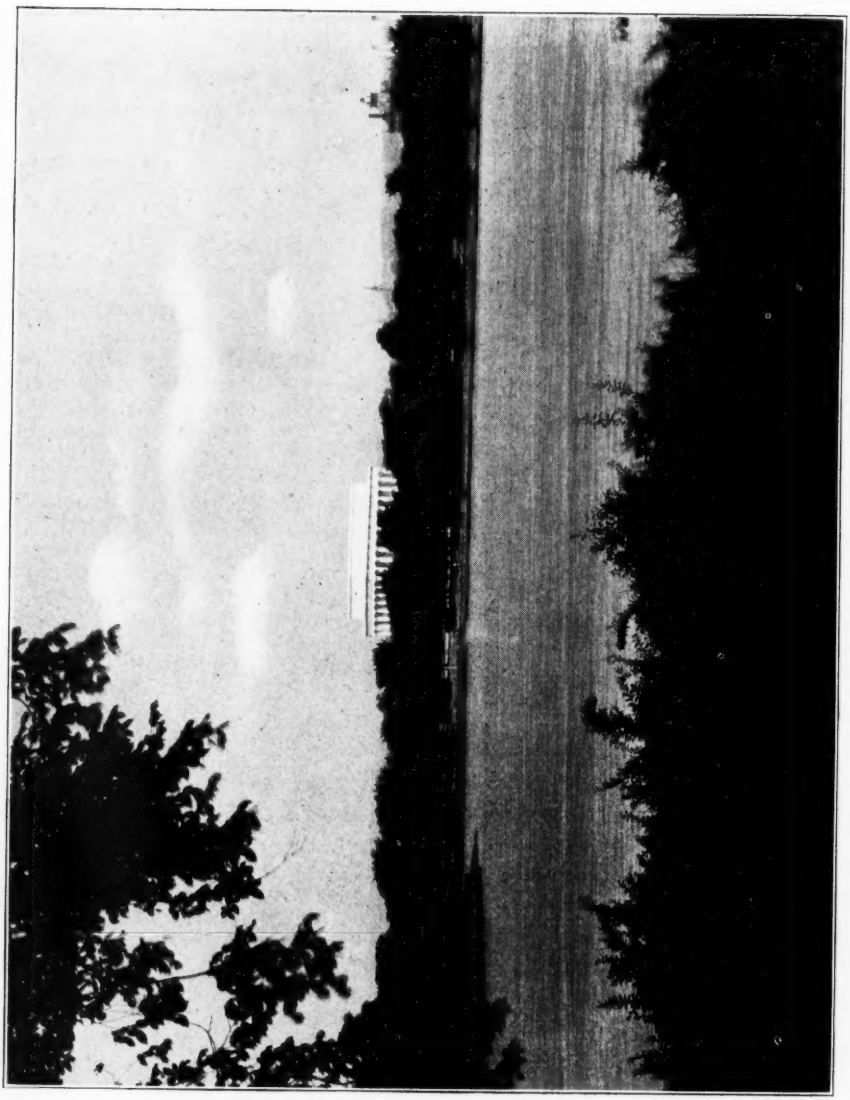
Round Table, 12:30 p. m., University Club.

Wednesday, October 9

Exchange Club, 12:30 p. m., Carlton Hotel.
Lions Club, 12:30 p. m., Mayflower Hotel.
Optimist Club, 12:30 p. m., Hamilton Hotel.
Rotary Club, 1:00 p. m., Willard Hotel.
Soroptimist Club, 12:30 p. m., Lafayette Hotel.

Thursday, October 10

Cosmopolitan Club, 12:30 p. m., Carlton Hotel.



Lincoln Memorial, Washington.

Kiwanis Club, 12:30 p. m., Washington Hotel.

Quota International, 12:30 p. m., 1624 I St., N. W.

Zonta Club, 12:30 p. m., Raleigh Hotel.

SCHOOL PROGRAM*

Tuesday, October 8

Wilson Normal, 11th and Harvard, N. W., 11:45 a. m.

Central High, 13th and Clifton, 9:00 a. m.

Eastern High, 17th and E. Capitol, 9 a. m.

Stuart Junior High, 4th and E St. N. E., 2:20 p. m.

Barnard Elementary, 5th and Decatur N. W., 9 a. m.

Park View Elementary, Newton and Warder N. W., 10:30 a. m.

Bryan Elementary, 13th and B. S. E., 9 a. m.

Wednesday, October 9

Business High, 9th and Rhode Island Ave. N. W., 9 a. m.

McKinley High, 2nd and T St. N. E., 9 a. m.

Western High, 35th and R St. N. W., 9 a. m.

Columbia Junior High, 7th and O St. N. W., 2:15 p. m.

MacFarland Junior High, Iowa and Webster N. W., 2:17 p. m.

Curtis Elementary, 33rd and O St. N. W., 9 a. m.

Cooke Elementary, 17th and Euclid, 9 a. m.

Burroughs Elementary, 18th and Monroe N. E., 9 a. m.

Petworth Elementary, 8th and Shepard N. W., 9 a. m.

West Elementary, 13th and Farragut N. W., 9 a. m.

Thursday, October 10

Brown Elementary, Connecticut and McKinley, 9 a. m.

*The hours of Central and Eastern High and MacFarland Junior High schools are subject to change.

ANNOUNCEMENTS

PAST PRESIDENTS LUNCHEON

The luncheon for the Past Presidents of the American Dental Association will be held Tuesday, October 8, at 12:30 p. m., in the Jefferson Room, Mayflower Hotel. Henry L. Banzhaf, Milwaukee, Wis., will be the presiding officer. The principal address will be made by F. O. Hetrick, Ottawa, Kan., and Mark F. Finley, Washington, D. C., will have charge of the local arrangements.

MOUTH HYGIENE LUNCHEON

The annual Mouth Hygiene Luncheon of the American Dental Association will be held at the Mayflower Hotel, Wednesday, October 9, at 1:15. Tickets, $1.50.

DISTRICT OF COLUMBIA DENTAL SOCIETY LUNCHEON

A luncheon will be given the Officers and Delegates of the American Dental Association by the District of Columbia Dental Society, in the Chinese Room, Mayflower Hotel, Monday, October 7, at 12:30 p. m.

TRAPSHOOTERS

The American Dental Trapshooters League will hold its seventh annual shoot Tuesday, October 8, at 1 p. m. Participants must be members of the American Dental Association in good standing. The contest will be on 100 targets at 16 yards, four twenty-five bird contests. A state team race will be held, and any state may enter five or more shooters. Each member of the winning team will receive a trophy. The Washington Gun Club has three traps in perfect condition and can take care of fifty shooting 100 targets each in three hours. The shooting grounds are fifteen minutes from the center of the city. Follow H Street east to Benning power station and turn left to the club.

WILLIAM D. MONROE, *Chairman*
1801 I St. N. W.
Washington, D. C.

ASSOCIATION OF AMERICAN WOMEN DENTISTS

Headquarters for the Association of American Women Dentists for the meeting, October 7, will be the Carlton Hotel, Washington, D. C. A banquet will be held at the hotel on this date. Haidee Weeks, New Orleans, is

Lincoln Memorial, Washington.

president of the Association and Wilhelmina Yeretsky, Grand Rapids, Mich., secretary-treasurer.

ASSOCIATION OF MILITARY DENTAL SURGEONS

The Association of Military Dental Surgeons will meet Wednesday, October 9, at 7 p. m., in the Italian Garden, Mayflower Hotel. Headquarters for the association will be the Mayflower Hotel.

C. T. MESSNER, *Chief of Dental Service,*
Bureau of the Public Health Service
Washington, D. C.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The next meeting of the National Association of Dental Examiners will be held in Washington, D. C., October 5.

GEORGE L. POWERS, *Secretary*
Bank of Commerce Bldg.
Memphis, Tenn.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

The eleventh annual meeting of the American Society of Oral Surgeons and Exodontists will be held at the Carlton Hotel, Washington, D. C., October 4-5.

E. B. BROWNING, *Secretary*
921 Boston Bldg.
Salt Lake City, Utah.

AMERICAN ACADEMY OF PERIODONTOLOGY

The sixteenth annual meeting of the American Academy of Periodontology will be held at the Carlton Hotel, Washington, D. C., October 3-5.

CLAYTON H. GRACEY, *Sec'y-Treas.*
269 Rowena St.
Detroit, Mich.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY

The next annual meeting of the American Academy of Restorative Dentistry will be held at the United States Chamber of Commerce Bldg., Washington, D. C., October 4-5.

RALPH L. MORRISON, *Sec'y-Treas.*
The Rochambeau
Washington, D. C.

AMERICAN SOCIETY FOR THE PROMOTION OF CHILDREN'S DENTISTRY

The regular annual luncheon meeting of the American Society for the Promotion of Children's Dentistry will be held at the Mayflower Hotel, Thursday, October 10, at 12:30 p. m.

F. BLAINE RHOBOTHAM, *President*
SAMUEL D. HARRIS, *Secretary*
2002 Eton Tower,
Detroit, Mich.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

The sixth annual convention of the American Dental Hygienists' Association will be held at the Hotel Powhatan, Washington, D. C., October 7-11.

AGNES G. MORRIS, *General Secretary*
886 Main St.
Bridgeport, Conn.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

The fifth annual meeting of the American Dental Assistants Association will be held in Washington, D. C., October 8-10. General headquarters will be the Hotel Hamilton.

RUTH F. ROGERS, *General Secretary*
223 W. Jackson Blvd.
Chicago, Ill.

PSI OMEGA FRATERNITY

The headquarters for the Psi Omega Fraternity will be the Raleigh Hotel. Headquarters will be open for registration, October 5-11. Supreme Council conferences will be held, October 5-8. The annual banquet will be given, Monday, October 7, at 7 p. m. The National Alumni Chapter business meeting will be held Tuesday, October 8, at 2 p. m.

H. E. FRIESELL, *Supreme Grand Master*
Schenley Apts.
Pittsburgh, Pa.

DELTA SIGMA DELTA

The forty-fifth annual meeting of the Delta Sigma Delta Fraternity will be held at the Willard Hotel, Washington, D. C., October 7. The opening session will be held at 9:30 a. m., and will be followed by a luncheon. The afternoon session will open at 2 o'clock

and will be followed by initiatory exercises. The annual banquet will be held in the same hotel at 6:30 p. m.

R. HAMILL D. SWING, *Supreme Scribe*
Elrae Bldg.
Philadelphia, Pa.

XI PSI PHI FRATERNITY

The Supreme Chapter of Xi Psi Phi will hold its biennial meeting at the Washington Hotel, Washington, D. C., October 4-5.

The Supreme Chapter banquet will be given October 7, at 6:30 p. m., at the Washington Hotel. All members of the fraternity are cordially invited to be present.

C. G. PARKER, *Supreme President*
David Whitney Bldg.,
Detroit, Mich.

ALPHA OMEGA FRATERNITY

The preconvention meeting of the Supreme Council of the Alpha Omega Fraternity will be held, Monday, October 7, at the Burlington Hotel, Washington, D. C. The meeting will be followed by a dinner. Those expecting to attend the meeting, notify W. I. Ogus, Farragut Apts., Washington, D. C. A new directory is to be published and your full name, address and school with class year is requested.

SAMUEL BIRENBACH, *Supreme Chancellor*
A. M. FLASCHNER, *Supreme Scribe*
419 Boylston St.
Boston, Mass.

New Hampshire Avenue, Washington.

Washington as seen from the Capitol.

MEMBERS OF THE HOUSE OF DELEGATES 1929

DELEGATES AND ALTERNATES

ALABAMA

Delegates

Olin Kirkland, Montgomery
J. A. Blue, Empire Bldg., Birmingham
Frank F. Perry, Montgomery

Alternates

R. J. McGavock, Woodward Bldg., Birmingham
F. A. Webb, Mobile
Charles F. Chandler, Montgomery

ARIZONA

Delegate

John A. Lentz, Phoenix

Alternate

Arch G. Fee, Tucson

ARKANSAS

Delegates

J. D. Jordan, Boyle Bldg., Little Rock
Nolan Helstern, Springdale

Alternates

W. G. Peay, Little Rock
Ellery C. Gay, Little Rock

ARMY DENTAL CORPS

Delegate

Robert T. Oliver, Univ. of Penn. School of Dentistry, Philadelphia, Pa.

Alternate

Julien R. Bernheim, War Department, Washington, D. C.

CALIFORNIA (SOUTHERN)

Delegates

Bert Boyd, Story Bldg., Los Angeles
J. P. Buckley, 1004 Taft Bldg., Hollywood
C. O. McBean, Hollingsworth Bldg., Los Angeles
M. M. House, 1001 Floral Drive, Whittier
E. Ray Brownson, 912 Roosevelt Bldg., Los Angeles
J. Franklyn Cook, 511 South Bonnie Brae, Los Angeles
W. H. Spinks, Roosevelt Bldg., Los Angeles

Alternates

C. H. Alter, Investment Bldg., Pomona
J. Elton Lang, Roosevelt Bldg., Los Angeles
M. M. Dixon, 1052 West Sixth St., Los Angeles
H. C. Newman, 609 South Grand Ave., Los Angeles
Nye W. Goodman, Story Bldg., Los Angeles
F. E. Hogeboom, 127 North Lucerne St., Los Angeles
N. F. Hirtz, Pacific Mutual Bldg., Los Angeles

COLORADO

Delegates

E. R. Warner, Metropolitan Bldg., Denver
W. T. Chambers, Metropolitan Bldg., Denver
C. S. Kramer, M. W. A. Sanitarium, Woodmen

Alternates

W. M. Bennett, State Bldg., Ft. Collins
Ezra E. Schaefer, Republic Bldg., Denver
R. L. Christy, Majestic Bldg., Denver

CONNECTICUT

Delegates

William L. Weed, 54 North Main St., South Norwalk
C. E. Peterson, 34 Park Place, Rockville
Albert E. Cary, 904 Main St., Hartford
Morton J. Loeb, 66 Trumbull St., New Haven

Alternates

Joseph W. Borchardt, 108 Bank St., Waterbury
Stanley E. Armstrong, 129 Whitney Ave., New Haven
Hubert Kohrman, 323 Main St., Danbury
Clarence G. Brooks, 302 State St., New London

DELAWARE

Delegate

Warren S. P. Combs, Middletown

Alternate

Clyde A. Nelson, Milford

DISTRICT OF COLUMBIA

Delegates

W. M. Simkins, 720 Woodward Bldg., Washington
Sterling V. Mead, 1149 16th St., N. W., Washington
Charles D. Cole, The Farragut, Washington

Alternates

Thomas J. Rice, The Farragut, Washington
C. Willard Camalier, 1029 Vermont Ave., Washington
M. F. Finley, 1927 I Street, N. W., Washington

FLORIDA

Delegates

C. J. Carraballo, Stovall Bldg., Tampa
C. C. Stewart, Hall Bldg., St. Petersburg

Alternates

A. B. Whitman, Orlando
B. L. Wilkerson, Professional Bldg., Miami

GEORGIA

Delegates

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Union Dental Instrument Mfg. Co., 831 Cherry St., Philadelphia, Pa.

Universal Dental Company, Brown & 48th Sts., Philadelphia, Pa.

Vernon-Benshoff Co., 1707 Clark Bldg., Pittsburgh, Pa.

Victor X-Ray Corp., 2012 W. Jackson Blvd., Chicago, Ill.

Weber Dental Mfg. Co., Canton, Ohio.

Wernet Dental Mfg. Co., 110 Beekman St., New York City.

Whip-Mix Corporation, Inc., 238 West Jefferson St., Louisville, Ky.

White Dental Mfg. Co., The S. S., 211 S. 12th St., Philadelphia, Pa.

Wiggin's Sons Co., H. B., Bloomfield, N. J.

Williams Gold Refining Co., 2978 Main St., Buffalo, N. Y.

Wilmot Castle Company, 1155 University Ave., Rochester, N. Y.

Wood Co., John H., 126 Market St., Philadelphia, Pa.

Wrigley Pharmaceutical Co., Vermont & Drexel Aves., Atlantic City, N. J.

Washington Auditorium.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Dental Granulomas: Rohdenburg and Franken (*J. A. M. A.*, July 20, 1929) report results of the examination of 165 granulomas, in an endeavor to determine the etiologic factors concerned in the development of these neoplasms. In forty-four instances, roentgen-ray examination revealed the location of the granuloma as follows: apex, nineteen; bifurcation, four; at both apex and bifurcation, fifteen; residual area, three, and at the stump of the excised apex, three. In this group, assistance was sought by four patients because of looseness of the teeth; by thirteen because of pain; by six, because of both looseness and pain; by ten because of roentgen-ray findings, and by one other because of these findings combined with pain, and by two, because of pain and a discharging abscess. Eight were referred by a physician in search of a focus of infection. The condition was found to occur slightly more frequently in women than in men. The average age of the patients was 40 in women and 44 in men. That these cysts do not always become infected was evidenced by culture, thirteen of sixty-five specimens being sterile, and by histologic examination, only eleven of 100 examined showing acute inflammatory changes of a suppurative type. The authors conclude that the so-called dental granuloma is primarily an epithelial cyst which most probably arises following irritation of the epithelial sheath of the tooth, the nature of this irritant being various. The epithelial cyst may, subsequent to its formation, become infected by a variety of micro-organisms, of which the most common is the nonhemolytic streptococcus.

Value of Ultraviolet Irradiation in Dentistry: The use of the water cooled mercury quartz burner in oral conditions is discussed by Wollenberger (*Arch. Phys. Ther. X-Ray Rad.*, July, 1929). This unit affords the middle and far ultraviolet rays, which are brought in direct contact by the interposition of the quartz applicators. The effect is selective for tissue cells as well as bacteria. The literature generally emphasizes the penetrating and bactericidal effects and fails to point out the cytocidal and tissue stimulating value. The outstanding quality of the ultraviolet ray is its power to be absorbed by tissue. If absorption takes place within physiologic limits, tonic and oxydizing reactions follow. Beyond that, depressing effects ensue, manifested locally by tissue necrosis, blistering of the gums and by a general feeling of malaise. Frequently, the dentist complains of variation in reaction in the same localities and with similar applicators. It is important that applicators be calibrated and measured as to transmission power before being sold to the profession. Only this can assure precision in treatment and uniformity of results, although a careful technic will give good results in a majority of cases, especially if selected. Preparation of the mouth for treatment is most important. In pyorrhea, the teeth should be thoroughly scraped and polished twenty-four hours before irradiation. A digestive ferment, caroid, is used to clean the area to be treated immediately before the quartz rod is applied. This removes tenacious mucin and any foreign material which may be present and which might prevent absorption of the rays. The applicators should be the clearest that can be obtained, as the transmission value of those containing bubbles is greatly diminished. Thorough treatment of one or two teeth at one sitting has proved more satisfactory in the long run than a mild application over a large area. In pyorrhea cases that can be classed as early or moderately advanced, the results have been good, the gums becoming harder and assuming the normal pinkness of health, recession ceasing and the teeth becoming firm in their sockets. The greatest field of usefulness covers the large group of subacute and chronic gingival

cases and affections of the gums that are forerunners of pyorrhea.

Unusual Association of Postinfantile Rickets with Osteomalacia: Three cases of postinfantile rickets associated with osteomalacia are reported by Blank and Graves (*Am. J. Dis. Child.,* July, 1929). The patients ranged in age from 3½ to 6 years. They were all colored. Examination revealed active rickets and the existence of defects of bone characteristic of osteomalacia, and the authors conclude that although the two processes have not been proved essentially identical, the observations recorded by them suggest that there may be no definite dividing line between these conditions. Recognition of postinfantile rickets and of osteomalacia, whether occurring singly or combined or as separate phases of an identical disease process, is considered of the utmost importance to the orthopedic surgeon, since no operation should be performed on patients in the active stage of rickets or osteomalacia.

Inheritance of Anhidrosis Associated with Anadontia: A case of toothlessness associated with baldness in which the condition could be traced through six generations is reported by Roberts (*J. A. M. A.,* July 27, 1929). The abnormal members of the family were characterized by (1) an entire absence of teeth or the presence of only a few, which were abnormal in shape and soft, whether deciduous or permanent; (2) anhidrosis, or an inability to sweat, and (3) scantiness of the hair of the head and absence or virtual absence of axillary hair. Roentgenograms of the jaws of one member of this family who was entirely toothless are shown. No rudimentary or undeveloped teeth are present. The absence of teeth caused the jaw bones to be very close together, with the result that the lips were thick and rolling and the face was malformed. The three structures affected have their origin in the ectoderm. The nails, however, were apparently normal. "From an inspection of the pedigree, it is obvious that these conditions are sex-linked. Three of the females were reported to have occasional 'patches' on the body which were smooth and in which the sweat glands did not function. This would indicate that the normal condition is not always completely dominant, though certainly as dominant as many characters which are so classed. The theoretical expectation of abnormal individuals on the basis of its being a sex-linked recessive character would be one in two among the males. The observed is nine in fifteen. This is on the supposition that inbreeding did not occur; and, as far as could be determined, there were no cases of intrafamilial marriages. The elimination of such characters in future generations is theoretically a simple matter. Normal sons from either normal or abnormal parents would not transmit the condition to either their sons or their daughters. However, normal appearing females if the father was abnormal would carry the defect, and such mothers, though normal in appearance, would in general transmit the defects to half their daughters and sons. If the father of these daughters and sons were normal, genes for the defects would not show up in the daughters except when the normal condition was not quite dominant but any son receiving the genes for the defects would show them."

Foreign Literature

Orthodontic Prophylaxis and Early Treatment of Orthodontic Anomalies (A. M. Schwarz, Ztschr. f. Stomatol., No. 4, 339, 1929): In spite of the fact that we must admire the many artful and successful apparatus that have been constructed during the last few years for the treatment of anomalies of the permanent teeth, those employed in the treatment of late cases are out of the question for the masses because of the high costs and the difficulties presented by these cases on account of the time involved. In order to aid the masses and to popularize orthodontic practice, we must first of all try to prevent the development of these deformities of the permanent teeth. A practical orthodontia must give consideration to the condition of the deciduous teeth, which in most cases show a tendency toward the anomaly that is to affect the permanent teeth. One of the most important questions in orthodontia is the etiology of these anomalies. Most investigators believed that constitutional or hereditary influences or internal secretions are responsible for these conditions. The author claims that most of the cases have none of the above mentioned origins but are due to outside influences that act directly on the individual and that call for an exact analysis of each case. Such an analysis is an aid in directing therapeutic procedure in some cases as well as prophylaxis in others. As most of the causative factors in these conditions are mechanical,

we should prevent every influence that may result in damage in later years. Prophylactic care should consist in operative treatment of the deciduous teeth and especially of the first permanent molars, which are of the greatest importance for the normal occlusion between the ages of 6 and 12 years; correcting bad habits, such as thumb sucking, mouth breathing and biting of the lips; care to establish good function of the jaws, and measures against rickets. Changes which occur in jaws primarily normal and which are caused by secondary mechanical influences the author calls "luxations of the bite." The most dangerous period in which luxation of the bite may occur is during the first two years of life, when the deciduous teeth erupt, and during the fifth and sixth years, when the first permanent teeth take their places. A seemingly unimportant circumstance, such as the position of the head during sleep, can, in this period of life, cause a luxation of the bite, with the consequent development of a marked anomaly, although the primary form and growth of the jaws may be normal. The dentist should watch the deciduous teeth, because a normal condition of the deciduous arch is the best preventive of anomalies of the later dentition. If for any reason an abnormality is already present, the jaws must first become "disoriented," which means that the child must be able to move the lower jaws in any direction and not be forced to place them in their former position. To disorient the jaws, the cusps are ground down and, in some cases, a plate is worn. After disorientation, the jaws are brought back to the proper position by the use of a chin cap, with the head in a dorsal position (Class III Angle), or the head may be placed in a forward position (Class II Angle). The head is held in the desired positions by simple bandages, the application of which is described in detail. In Class II cases, in order to train the muscles properly, the child has to exercise the lower jaw by bringing it forward. Another important point is the shape of the teeth and the amount of natural wearing down. Only if the deciduous teeth are worn down regularly in the fifth year of life will normal occlusion of the first permanent molars result. Normal occlusion of these teeth may also be rendered impossible by the presence of occlusal fillings with a faulty restoration of the fissures. The dentist must also watch the front teeth of the deciduous arch during the period before they are shed. Absence of spaces between the deciduous upper front teeth indicates that the upper arch is too narrow. In this case, the upper jaw must be expanded, and for this purpose the author uses the Stenton sliding device. It is not possible to review all the many practical ideas and suggestions that are presented in this paper. The main idea, as already mentioned, is to show the average dentist who is not specializing in orthodontia what he must keep in mind in caring for the child patient and how he can in a simple and easy way prevent much future damage.

RUDOLF KRONFELD, Chicago.

Filling Root Canals with Powdered Metallic Silver (A. M. Schwarz, Ztschr. f. Stomatol., No. 3, 195, 1929): The main reason for filling root canals with powdered metallic silver is the high oligodynamic power of this substance. Metals having this ability, especially silver, kill bacteria or stop their growth, when introduced into an infected culture medium. The oligodynamic power has no relation to the solubility of the metal, but is in direct relation to the surface area of the metal which is exposed to the surrounding medium. The author does not consider the method that he describes as a definitely tested and proven one: he is publishing it after two years of good clinical results and also after obtaining good results in the use of the silver powder in biologic control.[1] The silver powder was prepared by precipitating a concentrated watery solution of silver nitrate with a solution of hydrochinon (photographic developer). By this procedure, we get a very fine smooth dark powder, which is washed in a silk bag in running tap water and dried. For use, it is moistened with a few drops of alcohol, distilled water or any kind of a mild drug used in root canal treatment. The root canal must be very well cleaned and dilated. The moistened silver powder is brought into the cavity of the tooth with a little spoon or with a large excavator and then pushed into the root canal with elastic root canal pluggers or with broaches or files from which the tip has been cut off to make a kind of plugger. It is necessary to get the silver powder as high up as possible in the apical

1. Current Literature, J. A. D. A., 16:759 (April) 1929.

region. During the work, the root canal is moistened with distilled water or with any kind of drug used also to moisten the silver powder. After the apical portion of the root is filled, which can be recognized by the resistance to the plugger, more powder is added and condensed in the root canal. In the lower teeth, the filling material is easily inserted. For filling the upper teeth, the patient should be tipped back so far in the chair that the root canal is at least in a horizontal position. It is understood that a rubber dam must be used. If about the apical third or half of the root canal is filled with silver, the remainder can be filled with a guttapercha point. In cases of pulpless teeth showing apical absorption, sometimes the whole area is filled with silver powder, as shown in the roentgenogram. The tissues withstand this material very well and there is less reaction than with other materials. The silver powder passed through the apex in these cases is slowly absorbed and carried away by the tissues, as shown by roentgenograms taken at different times after the root is filled.

RUDOLF KRONFELD, Chicago.

Accessibility of the Root Canals of Five Hundred Teeth (Georg Stein, Ztschr. f. Stomatol., No. 5, 415, 1929): The suggestion of a few American writers that all pulpless teeth be extracted is in Europe considered too radical. While it is recognized that infected pulpless teeth may be a menace to the general health, it is hoped that apical foci can be eliminated by careful root canal work. The author considers that for satisfactory treatment of pulpless teeth, it is absolutely necessary that the main canal be accessible to the apex. Only when the root canal is very large and accessible throughout its entire length can good results be expected from our drugs and our filling methods. If for any reason the main canal cannot be filled satisfactorily, the pulpless tooth should be extracted. Whether a root canal can be filled in a way to insure good results, depends, apart from the anatomic conditions, on the technic employed and the ability of the operator. The author took roentgenograms of 500 teeth on which he had done root canal work in the last few years, to determine how many of the canals were well filled and in how many it had not been possible to reach the apex. The method employed for root filling was as follows: The canals were carefully enlarged with broaches and files; neoantiformin was used to dissolve the organic material in the canals, and the root was filled with guttapercha and powdered silver. Many of the teeth were found to have overfilled roots, especially teeth which were pulpless when treatment was started. Overfilling is not considered a mistake, especially if powdered silver was employed, as the surplus is soon absorbed by the tissues around the foramen, and does not cause any trouble. The accessibility of the root canals varied between nearly 100 per cent (central incisors) and about 80 per cent (lower second and third molars) of all teeth treated. The author extracts infected pulpless teeth in which there is not complete accessibility and satisfactory root canal filling is therefore impossible.

RUDOLF KRONFELD, Chicago.

MISCELLANY

BOOK REVIEWS

Dental Histology and Embryology. By B. Orban, M.D., Professor of Dental Histology and Pathology, Chicago College of Dental Surgery, Dental Department of Loyola University. Second Edition, revised and enlarged. 201 illustrations; 218 pages; price, $4.00. Published by P. Blakiston's Sons and Co., Inc., Philadelphia.

It should be a very strong recommendation for a book, particularly one on this topic, when a second edition is called for in less than a year. Professor Orban has brought to this study in certain respects almost a new point of view, and his investigations have added much to the knowledge of this most important subject. The photomicrographs in this work are exceptionally good and we note that there has been some substitution in the illustrations and some new ones added.

The mechanical makeup of the book is worthy of all commendation and reflects credit on the publisher as well as the author. It is a book that may be placed with all confidence in the hands of students, and it will serve as a stimulus to further study.

Full Denture Procedure. By Victor H. Sears, D.D.S., Professor of Prosthetic Dentistry, New York University College of Dentistry. Illustrated; 135 pages; price, $2.00. Published by The Macmillan Company, New York.

Instead of being a stereotyped textbook on the subject of full dentures, this little volume deals mostly with the laboratory procedure incident to the construction of full dentures. It does not consider the management of any but completely edentulous mouths and thus it has a definite technic to present, and one that can be followed by any student who has had preliminary training in denture work.

The author very modestly concedes that there are methods of procedure other than the one that he has outlined, but naturally claims for his technic the virtue of having a solid foundation to recommend it. We feel that this little book will serve a very useful purpose, and that it will enjoy a wider reading than some of the larger and more pretentious volumes.

Dental Anatomy. A graphic presentation of tooth forms with an original technique for their reproduction. By M. Diamond. D.D.S., Associate Professor of Dentistry and Head of the Department of Dental Anatomy, Columbia University Dental School. Illustrated; 300 pages; price, $5.00. Published by The Macmillan Company, New York.

An accurate knowledge of dental anatomy is the foundation of successful technic in all such procedures as the filling or crowning of teeth, and even in partial denture construction. Therefore, the more literature we have on this subject, the better.

In the present volume Dr. Diamond has stressed tooth form as it applies to many of our technical procedures and has thus made a book of practical value.

He has a most interesting chapter on "The Pulp Chamber and Pulp Canals," which will be found of value in the management of pulpless teeth. This chapter, while not long, is worthy of careful study. The book throughout will aid greatly in disseminating knowledge of this important subject, and it is accordingly to be highly commended.

NEWS

North Carolina Society Officers: The newly elected officers of the North Carolina Dental Society are: President, J. H. Wheeler, Greensboro; vice president, D. E. McConnell, Gastonia; secretary-treasurer, Dennis F. Keel, Greensboro.

Storage of Roentgen-Ray Films: The Chicago Roentgen Society has passed a resolution stating that the storage of used roentgen-ray films has become an economic and insurance problem; that the reports of roentgenologists who are responsible for the diagnosis are of much more value and importance than the films, and that these reports make it unnecessary that large quantities of old films be preserved for a longer period than two years. The society deems it unnecessary in cases in which there is no likelihood of a legal procedure, to retain roentgen-ray films longer than six months. The society does not discourage the preservation of films of especially interesting conditions in view of their usefulness for teaching. It also declared it proper for roentgenologists to deliver films to physicians who refer a particular patient to them in case the referring physician desires to preserve the film.—*J. A. M. A.,* July 20, 1929.

Deaths

Hawley, Charles A., Washington, D. C.; University of Michigan, School of Dentistry, 1893; died, July 22, after an operation.

Huntington, Charles Warner, Harrisburg, Pa.; Temple University School of Dentistry, 1888; died, June 20. Dr. Huntington practiced dentistry in Williamsport for forty-three years.

Jackson, A. M., Miami, Fla.; Southern Dental College, 1908; died, June 28, after a year's illness; aged 44.

Smith, James Douglas, Jacksonville, Ill.; Vanderbilt University, School of Dentistry, 1893; died, July 10; aged 59.

Williams, Clarence Walter, Kankakee, Ill.; Chicago College of Dental Surgery, 1892; died, June 7; aged 62.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Dental Association, Washington, D. C., Oct. 7-11, 1929.

American Academy of Periodontology, Washington, D. C., Oct. 3-5, 1929.

American Dental Assistants Association, Washington, D. C., Oct. 7-10, 1929.

American Dental Hygienists Association, Washington, D. C., Oct. 7-11, 1929.

American Full Denture Society, Washington, D. C., Oct. 1, 1929.

American Society for the Promotion of Children's Dentistry, Washington, D. C., Oct. 10, 1929.

Association of American Women Dentists, Washington, D. C., Oct. 7, 1929.

National Association of Dental Examiners, Washington, D. C., Oct. 5, 1929. George L. Powers, Secretary, Memphis, Tenn.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

January (1930)

Pennsylvania, at Harrisburg (30-31).

April (1930)

Connecticut, at Stamford (22-24).

May (1930)

North Carolina, at Asheville (5-8).

First District Dental Society of New York, Dec. 10-14, 1929.

Southwestern Dental Society, El Paso, Texas, October, 1929.

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*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Connecticut, at Hartford, November 18-21. A. J. Cutting, Recorder, Southington.

Indiana, at Indianapolis, November 11. J. M. Hale, Secretary-Treasurer, Mt. Vernon.

New Jersey, at Trenton, December 2-7. John C. Forsyth, Secretary, 148 W. State St., Trenton.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet in Hartford, November 18-21, for the examination of applicants for license to practice dentistry and dental hygiene, and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least one week before the meeting. For application blanks and any further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

PENNSYLVANIA STATE DENTAL SOCIETY

The Midwinter Meeting of the Pennsylvania State Dental Society will be held, January 30-31, in the Penn-Harris Hotel, Harrisburg.

RICHARD D. CROWLEY,
Publicity Committee,
111 N. Second St.,
Harrisburg.

INDIANA BOARD OF DENTAL EXAMINERS

The Indiana Board of Dental Examiners will meet at 8 a. m., at the State House, Indianapolis, in the room of the House of Representatives, for the purpose of examining all applicants with proper credentials. Applications should be in the hands of the secretary one week before the board meeting. For applications, clinical requirements and other information, address

J. M. HALE, *Sec'y-Treas.,*
Mt. Vernon.

THE STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

The State Board of Registration and Examination in Dentistry of New Jersey will hold its regular examinations at Trenton, commencing December 2 and continuing for five days thereafter. The examination fee is $25; reexamination fee, $10.

Practical tests required: Insertion of an approximal gold filling, with the approximating tooth in position, compound approximal amalgam filling and a silicate filling; the candidate to furnish his own patient. Taking of impression, bite, selection of teeth, articulation and trial denture; the candidate to furnish his own patient. Practical examination in mouth diagnosis.

Attention is invited to the following quotation from the dental law of New Jersey: "Applicant shall present to said board a certificate from the commissioner of education of this state, showing that before entering a dental college he or she had obtained an academic education consisting of a four-year course of study in an approved high school, or the equivalent thereof."

In accordance with this law, the secretary will issue application blanks only on presentation of the required certificate from the commissioner of education, State House, Trenton.

Application must be filed complete ten days before the date of examination (November 22).

Address all communications for further particulars to

JOHN C. FORSYTH, *Secretary*,
148 W. State Street,
Trenton.

GREATER NEW YORK DECEMBER MEETING FOR BETTER DENTISTRY

The First and Second District Dental societies will continue the series of meetings which were formerly conducted by the First District Dental Society and widely known as the "December Meeting for Better Dentistry." The meeting this year, which is the Fifth Annual Meeting, will therefore be conducted jointly by the two societies at the Hotel Pennsylvania, December 9-13.

Among the essayists and clinicians who have accepted invitations to be present are: Wallace Seccombe, Toronto, Canada; John B. LaDue and J. R. Blayney, Chicago, Ill.; Chalmers J. Lyons, Ann Arbor, Mich.; Charles A. Lane, Albert L. LeGro and P. Kyprie, Detroit, Mich.; Dayton D. Campbell, Kansas City, Mo.; James M. Prime, Omaha, Nebr.; Hugh W. MacMillan, Cincinnati, Ohio; and Theodore W. Maves, Cleveland.

The meeting will be continued on the same plan as previous meetings; i.e., $5.00 admits members to all lectures, clinics, etc. A subscription blank and list of clinics will be ready for circularization, November 1.

There will be a manufacturers' exhibit in the hotel during the meeting.

JOHN T. HANKS, *Chairman.*

NOTICE TO DENTISTS LICENSED TO PRACTICE IN IOWA

Section 2447 of the Code of Iowa provides that every license to practice dentistry or any other profession will expire on the thirtieth day of June following the issuance of such license and shall be renewed annually on application by the licensee without examination but on payment of one dollar annual renewal fee.

This department is informed that a number of dentists are practicing in Iowa who have not made the annual renewal of license as has been required by law during the past five years. Such dentists are in reality practicing without a license and may be stopped from practicing their profession at any time.

Section 2448 of the code provides that any dentist who allows his license to lapse by failing to renew the same may be reinstated without examination on recommendation of the state board of dental examiners and on payment of the renewal fees then due.

If there is any dentist licensed or holding a dental certificate of Iowa who has not renewed his license in any of the last five years, he should immediately send a check or money order for $5 to the state department of health, accompanied by a letter to the effect that it is for the renewal of license. If the lapse has been for only two or three years, the renewal fee should be in accord, that is $1 for each year. When sending it in, please give your name, address and the original state license number.

The state board of dental examiners recently decided that "if any licensee has

allowed his license to lapse by failing to renew the same as provided by law and is not reinstated on December 31, 1929, the state board of dental examiners will not recommend reinstatement but will require that any applicant for reinstatement delinquent on that date shall be required to pass the practical portion of the regular examination, which will carry with it the regular fee."

It is therefore of great importance that every dentist holding Iowa licenses have his renewal fees paid up to date, including the fee for the year and to June 30, 1930.

HENRY ALBERT, M. D.,
Commissioner,
State Department of Health.

June 25, 1929.

ST. LOUIS STUDY CLUB OF DENTISTRY

The St. Louis Study Club of Dentistry, organized in 1919 for the purpose of teaching advanced dental courses to ethical dentists, without charge, will open its twelfth annual term early in September. The session will be held on Wednesday evenings from 8 to 10 p. m. All classes will be given in the St. Louis University College of Dentistry.

The following subjects will be covered during this term: dental economics; dental roentgenology; fixed bridge technic; full dentures; dental ceramics; conduction and local anesthesia; rizadontia (root canal technic); operative dentistry; oral prophylaxis; anatomy and dissection of the head; oral diagnosis and diseases of the mouth, and tooth form and cavity preparation.

Bulletins, giving detailed information regarding the study club and its courses, may be had by addressing F. C. Rodgers, 309 Wall Building, St. Louis, Mo.

PROFESSIONAL COURSES IN DENTISTRY

In the University of California, courses in dental subjects will hereafter be included as a part of the regular curriculum of the extension division. Particulars in connection with these courses may be had by writing John W. Leggett, University Extension Building, 540 Powell St., San Francisco.

AID ASKED FOR INCAPACITATED DENTIST

Graz, July 12, 1929.

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION,

Chicago, Illinois.

We are requested to state that Mr. Ernst Reiterer of 11 Jakominiplatz, Graz, Austria, is an authorized dentist, and has been a member of our dental association for many years. He was born Oct. 11, 1881, in Vienna, and is married.

He has been suffering badly from tuberculosis since 1924, which incapacitates him for practice. Our dental association, having no money to help him, appeals to the profession of America to lend him aid.

Fraternally yours,
THE AUTHORIZED DENTAL SOCIETY OF GRAZ,
By the President,
Gottfried Klimirch

LADIES' AUXILIARY, A. D. A.

The Ladies' Auxiliary of the American Dental Association will meet at 10 a. m., Monday, October 7, in the Pan-American Room of the Mayflower Hotel, Washington, D. C.

CORRECTION

C. T. Messner, chief of the Dental Service, Bureau of the Public Health Service, Washington, D. C., calls attention to the fact that the article by Dr. Vignes, "Dentistry Among the Lepers," in the August issue of THE JOURNAL, may leave the impression that the hospital for lepers at Carville, La., is operated by the Army and that Dr. Prejean is an Army dental surgeon. The hospital is operated by the U. S. Public Health Service and Dr. Prejean is a dental officer of that service and not of the Army.

RAILROAD RATES TO WASHINGTON, D. C.
CHANGE IN PLAN.

The American Dental Association is discontinuing the use of the Identification Convention Certificate, and this year is using the "Certificate Plan." The certificates will be obtainable from your railroad agent, and NOT THROUGH THIS OFFICE. Full information will be sent to each member of the Association, giving dates of sale of tickets in all sections of the United States.

The following directions are submitted for your guidance:

1. Be sure that when purchasing going ticket you request a CERTIFICATE. *Do not make the mistake of asking for a "receipt."*

2. Present yourself at the railroad station for tickets and certificates at least thirty minutes before departure of train on which you will begin your journey.

3. *Certificates are not kept at all stations.* If you inquire at your home station, you can ascertain whether certificates and through tickets can be obtained to the place of meeting. If they are not obtainable at your home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket to the station which has certificates in stock, where you can purchase a through ticket and at the same time ask for and obtain a certificate to the place of meeting.

4. *Immediately on your arrival at the meeting present your certificate* to the endorsing officer, Harry W. Nelson, Vice-President, as the reduced fares for the return journey will not apply unless you are properly identified as provided for by the certificates.

5. It has been arranged that the special agent of the carriers will be in attendance, October 7-11, from 8:30 a. m. to 5:30 p. m., to validate certificates. If you arrive at the meeting and leave for home again prior to the special agent's arrival, or if you arrive at the meeting later than October 11, after the special agent has left, you cannot have your certificate validated and consequently you will not obtain the benefit of the reduction on the home journey.

6. Certificates issued to children at half fares will be counted the same as certificates held by adults.

7. If your certificate is duly validated, you will be entitled, up to and including October 15, to a return ticket via the same route over which you made the journey *at one-half of the regular one-way tariff fare* from the place of meeting to the point at which your certificate was issued.

8. Return tickets issued at the reduced fares will not be good on any limited train on which such reduced fare transportation is not honored.

9. *No refund of fare will be made on account of failure to obtain a proper certificate when purchasing going tickets, nor on account of failure to present a validated certificate when purchasing return ticket.*

TRUNK LINE ASSOCIATION

Sale dates for New York State (east of and including Buffalo, Niagara Falls, Suspension Bridge and Salamanca), New Jersey, Pennsylvania (east of and including Erie, Oil City and Pittsburgh), Delaware, Maryland, District of Columbia, Virginia and West Virginia (east of and including Wheeling, Parkersburg, Kenova, Orange and Norfolk).....Oct. 3-9*

Final honoring date.....Oct. 15

TRANSCONTINENTAL PASSENGER ASSOCIATION

WESTERN PASSENGER ASSOCIATION

Sale dates for Colorado (Julesburg only), Illinois, Iowa, Kansas, Manitoba†, Minnesota, Missouri, Nebraska, Nor. Michigan, North Dakota, South

*Dates quoted are inclusive.

†Manitoba (on Great Nor., Nor. Pac. and M., St. P. & S. S. M. Rys., also from Winnipeg via Can. Nat'l and Can. Pac. Rys.).

Dakota, Wisconsin ..... Oct. 3-9
Colorado (except Julesburg), New Mexico, Wyoming ..... Oct. 2-8
Arizona, British Columbia, Idaho, Montana, Nevada, Utah, Oregon (except via California), Washington ..... Oct. 1-7
California ..... Sept. 30-Oct. 6
Oregon (via California) ..... Sept. 29-Oct. 5
Final honoring date ..... Oct. 15

SOUTHEASTERN PASSENGER ASSOCIATION

Sale dates for points in territory (south of the Ohio and Potomac and east of the Mississippi Rivers) ..... Oct. 3-9
Final honoring date ..... Oct. 15

NEW ENGLAND PASSENGER ASSOCIATION

Sales dates for points in territory (New England) ..... Oct. 3-9
Final honoring date ..... Oct. 15

SOUTHWESTERN PASSENGER ASSOCIATION

Sale dates for Oklahoma, Texas ..... Oct. 2-8
Arkansas, Kansas, Louisiana, Missouri, Memphis, Tennessee, and Natchez, Miss. ..... Oct. 3-9
Final honoring date ..... Oct. 15

CANADIAN PASSENGER ASSOCIATION—WESTERN LINES

Sale dates for British Columbia ..... Oct. 1-7
Alberta ..... Oct. 2-8
Saskatchewan, Manitoba, Ontario (west of Port Arthur and Armstrong) ..... Oct. 3-9
Final honoring date ..... Oct. 15

CANADIAN PASSENGER ASSOCIATION—EASTERN LINES

Sale dates for points in territory (Canada—east of and including Armstrong and Fort William and Sault Ste. Marie, Ont.) ..... Oct. 3-9
Final honoring date ..... Oct. 15

CENTRAL PASSENGER ASSOCIATION

Sale dates for points in territory (west of Buffalo, Niagara Falls, Salamanca, Pittsburgh, Wheeling, Parkersburg, and Kenova to and including Chicago and St. Louis, and north of the Ohio River, including Cincinnati, Louisville and Cairo) ..... Oct. 3-9
Final honoring date ..... Oct. 15

HOTELS	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
BLACKSTONE 17th St., Btw. K. & L.	100	$3.00-5.00	$5.00-6.00		
BURLINGTON Vermont Ave. Thomas Circle	200	3.00-4.00	5.00-7.00	$2.50	$4.00
CAPITOL PARK N. Capitol & E.	150	3.00-4.00	4.00-6.00	2.00 up	3.00 up
CARLTON 16th & K. St.	260	5.00-7.00	8.00-12.00		
COMMODORE N. Capitol & F.	154	2.50-3.50	4.50-6.00		
CONTINENTAL N. Capitol & E.	250	3.00-4.00	5.00-7.00	2.00-2.50	3.00-4.00
DRISCOLL 1st & B. Sts.	200	3.50	6.00	2.00 up	3.00 up
EBBITT 1000 H. St.	150	2.50-3.00	4.00-5.00		
GRACE DODGE N. Capitol & E.	300	3.00-4.00	5.00-8.00	2.50-3.00	4.00-5.00
GRAFTON Conn. Ave., Btw. L. & N.	125	3.50-6.00	5.00-8.00	2.50-3.50	4.00-5.00
HARRINGTON 11th & E.	300	2.50-5.00	5.00-8.00	2.50 up	3.50-5.00
LAFAYETTE 16th & Eye Sts.	200	4.00-6.00	6.00-8.00		
MAYFLOWER Connecticut Ave.	650	5.00-10.00	7.00-15.00		
METROPOLITAN 6th & Pa. Ave.	175	2.50	4.00 up	1.50 up	3.00 up
POWHATAN Pa. Ave. & 18th	300	3.00-5.00	6.00-9.00		
RALEIGH 12th & Pa. Ave.	460	4.00-6.00	5.00-10.00	3.00-4.00	4.00-6.00
WARDMAN PARK Conn. Ave. & Woodley	400	uniform rate $5.00	uniform rate $8.00		
WASHINGTON Pa. Ave. & 15th	400	5.00-8.00	8.00-12.00		
WILLARD Pa. Ave. & 14th	475	5.00-10.00	7.00-15.00		
WINSTON 1st & Pa. Ave.	100	2.50 up	4.00 up	1.50 up	3.00 up

AMERICAN DENTAL ASSOCIATION

Washington, D. C. October 7-11, 1929.

HOTEL RESERVATIONS

In securing hotel reservations for the 1929 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation which they make for you.

In case your first choice cannot be made, indicate second and third choices. If none of your choices are available, the hotel manager will mail your application to the Chairman of the Halls and Hotels Committee and he will place your reservation in as favorable a hotel as possible.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely to occupy the room at time agreed on, please write or wire the hotel releasing it, in order that your room may be available for other members.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, WASHINGTON, D. C., OCT. 7-11, 1929

.....Hotel. .....1929.
Washington, D. C.

Please reserve sleeping room accommodations as noted below:

.....room(s) with bath for.....people. Rate desired per day $.....

.....room(s) without bath for.....people. Rate desired per day $.....

Second choice hotel.....

Third choice hotel.....

ROOMS TO BE OCCUPIED BY: ADDRESS IN FULL

Applicant..... .....

....

....

....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

Important to Hotel Manager: In the event you cannot accept this reservation, please forward this application at once to Dr. R. L. Morrison, Chairman Halls and Hotels Committee, Suite 706, 1103 Vermont Ave., N. W., Washington, D. C., who will attend to the assignment of this reservation.

LIBRARY BUREAU

of the

AMERICAN DENTAL ASSOCIATION

58 E. Washington St.,

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Though approximately a thousand members of the American Dental Association have availed themselves of the services of the Library Bureau during the past year, there are still a great number of dentists who are not familiar with the material offered for circulation by the Bureau. Three distinct types of service are given:

PACKAGE LIBRARIES, consisting of magazine clippings, reprints and excerpts on requested subjects. A charge of 50 cents is made for the loan of each package. A package is devoted to one subject only and the average package contains about twenty articles. In the June issue of THE JOURNAL, pages 1148-1150, a partial list of the package libraries available to the members was given.

BOOK CIRCULATION, giving members the privilege of borrowing books. A $2.00 deposit is requested for each book. This is refunded on the return of the book unless the member asks that it be retained as a standing deposit. Books and package libraries are loaned for one week after date of receipt by the borrower, and the time will be extended on request unless the material has been called for by someone else. A list of the recent books available for circulation was published in the July issue of THE JOURNAL, pages 1343-1346.

BIBLIOGRAPHIES, listing references to books and magazine articles. A charge of $1.00 is made for ordinary service. Estimates will be given on exhaustive research work. At present only a limited amount of bibliography work can be undertaken.

The Library Bureau receives dental journals from all over the world. In addition to those published in the United States, journals printed in English come from England, Australia, New Zealand, Canada and India. Journals in a number of foreign languages are also currently received. The most important dental journals are bound each year and are available for reference work. The Library has copies of the "Index of the Dental Periodical Literature," compiled by Dr. A. D. Black, and also the "Quarterly Cumulative Index Medicus." The bound volumes of journals which are not circulated, used in conjunction with the medical and dental indexes, are invaluable for reference work. Quite a few medical journals are also subscribed for. Among these are *The Journal of the American Medical Association, The New England Journal of Medicine, California and Western Medicine, Illinois Medical Journal, The Journal of the Indiana State Medical Association, Archives of Physical Therapy, X-ray and Radium, Journal of the National Medical Association, Current Researches in Anesthesia and Analgesia, The American Journal of Surgery* and the *American Journal of Diseases of Children.*

Members in the vicinity are cordially invited to use the Library for reading or reference purposes and all members when in the city will be most welcome to visit the Library, to acquaint themselves with the material at hand.

The Library has been greatly enlarged recently and now has ample space to accommodate those who wish to work here.

(Mrs.) JOSEPHINE P. HUNT,
Librarian.

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1929

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